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Cover: A Good Paddy Crop

[*Photo by* P. R. R. Pillai]

The Mysore Agricultural Journal

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Editorial

REPORT OF THE SECOND JOINT INDO-AMERICAN TEAM ON AGRICULTURAL EDUCATION, RESEARCH AND EXTENSION

THE Report of the Second Indo-American Team jointly set up by the Government of India and the T.C.M. authorities makes really interesting reading. The Second Team had been set up to assess the progress made during the past five-year period and recommend a course of action for the Third Five-Year Plan not only at the Centre but also in the States.

The Report covers a wide ground of Agriculture under the heads of Education, Research and Extension. One of the important general recommendations made by the Team is that the agricultural institutions and organisations should be under the administrative control of men who have an agricultural background. We agree with the Team that this is a sound suggestion. While dealing with Research, the Team suggests that the overall agricultural research programme in the country should be substantially enlarged and more facilities are given to tackle with the most important problem of increased agricultural production. It also stresses that major problems should determine India's Agricultural Research policy. Co-ordination of all research programmes by a central body like the I.C.A.R. is essential and all the existing Commodity Committees and the Central Research Institutes should be brought under the full technical and administrative control of the I.C.A.R. To improve the quality of Agricultural Research, the Team suggests a number of measures like the incentive awards, improved salary scales, etc. Under 'extension' the Report suggests, among other things, a common pattern of organization from the Central Government down to the village level. It suggests that Agriculture and Animal Husbandry Departments should provide the techniques, Panchayats the Organization and Co-operative Department, the Finance and all these four should be linked up effectively.

On the whole, we consider the Report very important and earnestly hope that all concerned will give careful thought to the recommendations made by the Team. The country is on the threshold of the Third Five-Year Plan and, as stressed more often than once, our basic

problem is "More Agricultural Production". We are sure that the implementation of the Team's recommendations go a long way towards achieving the above objective.

Research Articles

PROMISING RUST-RESISTANT STRAINS OF WHEAT FOR MYSORE STATE

By B. H. Katarki*

Introduction

India, with an area of about 29·2 million acres under wheat and a production of nearly 8·3 million tons, occupies fifth position in the acreage and seventh in the total production amongst the wheat-growing countries of the world. Nearly 90% of the total area under wheat in India lies north of the line drawn from Bombay to Calcutta. Bread wheat belonging to *Triticum valgare* sp. is grown mostly in Northern India while hard wheat belonging to *Triticum durum* sp. is centralised in Central and Western India.

Cultivation

The wheat cultivation in Mysore State is mainly concentrated in Ceded Districts of erstwhile Bombay and Hyderabad States, which accounts to 3% of the total acreage under wheat in India, thus acclaiming a very important wheat belt in Southern India. Hard wheat belonging to *Triticum durum* sp. is cultivated as a *rabi* cereal in Mysore State and is known for early maturity and high macroni quality. Wheat as a nutricious cereal occupies a very important place in the diet of the people of Northern Districts of Mysore State.

Damage Caused by Wheat Rust

The wheat crop is subject to severe losses mainly due to the disease called 'Black Stem Rust' [*Puccinia graminis tritici* (Pers.)], while leaf rust (*Puccinia triticina* Erik) and yellow or stripe rust [*Puccinia glumarum* (Schm.) Erik and Henn] are known to cause lesser damage to the crop. The annual loss to the wheat crop, in India, due to rust damage, is estimated at Rs. 4·90 crores (Vasudeva and Prasad, 1948). The black stem rust does the greatest damage to wheat crop in Indian plains where higher temperature conditions prevail (Dastur and Pal, 1947). The physiological races and biotypes of black stem rust so far observed in India are: 15, 15 C, 21, 24, 34, 40, 42, 42 A, 42 B, 72, 75, 117 (53), 122 and 194 (Patel and Gokhale, 1957), out of which 40, 42, 42 A, 42 B, 21 are highly virulent and frequent (Vasudeva *et al.*, 1955).

* Agricultural Demonstrator I/C, Agricultural Research Station, Annigeri, District Dharwar.

Breeding Rust-Resistant Varieties of Wheat

Considering the magnitude of losses to the wheat cultivation due to the damage caused by rust disease, a full-fledged Research Station was started at Mahabaleshwar in erstwhile Bombay State in 1942 entirely devoted to assist the wheat breeders of Bombay and Madhya Pradesh States to work for the isolation of rust-resistant varieties. The work was intensified in the Research Station when new schemes for the improvement of cereals, pulses and oilseed crops started functioning from 1947. Accordingly, wheat improvement work was taken up at the Agricultural Research Station, Annigeri, in 1947.

Black stem rust (*Puccinia graminis tritici*) being a highly destructive one, breeding for resistance to this particular disease was given priority. Various bulk samples of wheat, collected from all over the *durum* wheat track of Mysore State, were subjected to selection pressure as a result of which high yielding quality types were isolated. All these types were highly susceptible to black stem rust. Gaza, a Canadian wheat, was the only available rust-resistant *durum* variety and as such it was hybridised in 1949–50 with high yielding quality types isolated from local wheat. Further generations of this synthetic material were studied at the Agricultural Research Station, Annigeri, for agronomic characters and at the Agricultural Research Station, Mahabaleshwar, for rust reaction. Now the material is in advanced generations and few cultures possessing a good combination of economic characters and rust-resistance are at hand (Katarki and Banahatti, 1958). The more important cultures amongst them, which are under replicated trials on large plot basis, are specified in Table I together with their agronomic value and rust reaction.

It is observed from the two years' performance that all the 13 cultures are *at par* in yield with the local besides possessing better grain quality and high resistance to black stem rust. The high resistance to black stem rust recorded by these cultures even under severe epidemic conditions artificially created at Mahabaleshwar is a great achievement. The local red wheat under such conditions succumbs to rust completely, producing highly shrivelled grains or no grains at all. All these cultures are under seedling test against individual races of rust during 1959–60. Four cultures, *viz.*, 3 F 12–27, 3 F 10–83, 3 F 10–103 and 9 F 9–186 out of the lot are under district trials during 1959–60.

Besides, 3 F 10–76, 3 F 10–77, 3 F 10–78, 3 F 10–79 and 3 F 10–81 are heavy tillering cultures as compared to local wheat thus indicating a trend towards higher yield. They being late by about a week in maturity, seem to yield well under irrigation than under rainfed condi-

tions. Further trials on these cultures, under irrigated conditions, are under way.

The other ancillary data such as plant height, number of effective tillers, spike length, etc., collected on these important cultures are tabulated in Table II. It is observed that most of these cultures possess good plant height. Some cultures possess tillering capacity equal to the local wheat variety. As regards the spike length and the number of spikelets per spike, all cultures, except 22 F 9–152 and 22 F 9–155, show definite increase over that of local wheat variety.

Future Programme of Wheat Breeding Work

It is encouraging to note that rust-resistant wheat strains are under district trials for judging their yielding capacity in comparison with the local wheat variety and it will not be far when outstanding one amongst them will be released for general cultivation in the districts. In this connection, it may be stated that the variety evolved from the local, Gaza synthetic material can only yield *at par* with the local wheat variety and not significantly superior to it as Gaza itself is a low yielder. As such, the new rust-resistant strain can only assure equal yield to the local besides possessing high resistance to black stem rust.

Secondly, this research achievement cannot offer a permanent solution in combating various races of rusts prevailing. The present synthetic material with Gaza breaks down to 15° C. race of black stem rust as Gaza itself is susceptible to it (Gokhale, 1950). Fortunately, however, this race is not of frequent occurrence in India. Again, the problem of breeding rust-resistant *durum* wheats has to account for new physiological races that are likely to be virulent in future.

Brown and yellow rusts are also reported to cause heavy losses to wheat crops in northern and central parts of India while damage of that magnitude is not noticed at present in wheat tract of Mysore State. But, a minor problem of the present may magnify and stand as a menace in future. Hence, while breeding for rust-resistance in wheat, it would be a wise thing to formulate a comprehensive breeding programme so as to include all the three types of rusts. New sources are to be tapped for other resistant *durum* material. Introducing short duration *T. valgare* wheat varieties and, if necessary, interspecific crosses may be affected and exploited. Hence, the breeder's effort to find new races of rust is continuous.

TABLE I

Agronomic and Economic Characters of Rust-Resistant Synthetic Wheat Cultures

Sl. No.	Cultures	Season	Per acre yield in lb.	100 Gr. wt. in gm.	No. of days to flower	Rust re-action*	Per acre S.E.	Per acre C.D.	Remarks
1	2	3	4	5	6	7	8	9	10
1	3 F 13–1	1957–58	748	5·00	58	RSR	191	390	*At par* in yield with the local variety
		1958–59	975	4·70	61	SRMS	98	191	do.
		Average	861	4·85	59				
2	3 F 12–27	1957–58	390	4·82	59	SRMS	32	65	*At par* in yield with the local variety
		1958–59	1,030	4·27	59	SRMS	70	136	do.
		Average	710	4·54	59				
3	3 F 12–30	1957–58	633	5·00	59	SRMS	96	195	*At par* in yield with the local variety
		1958–59	979	5·32	60	SRMS	..	..	Experiment is not significant.
		Average	806	5·16	59				
4	3 F 12–52	1957–58	792	4·92	55	RSR	92	189	*At par* in yield with the local variety
		1958–59	1,120	4·83	61	SR	70	134	do.
		Average	956	4·87	58				
5	3 F 10–82	1957–58	318	4·61	55	SRMS	..	..	Experiment is not significant.
		1958–59	1,005	3·94	58	SRMS	71	137	*At par* in yield with the local variety
		Average	661	4·27	56				
6	3 F 10–83	1957–58	461	3·47	58	SR	94	192	*At par* in yield with the local variety
		1958–59	1,075	3·50	58	SR	70	137	do.
		Average	768	3·48	58				

7	3 F 10–95	1957–58	653	4·24	57	SRMS	104	214	*At par* in yield with the local variety
		1958–59	1,037	4·14	56	SRMS	70	136	do.
		Average	845	4·19	56				
8	3 F 10–102	1957–58	653	3·96	58	SRMS	94	192	*At par* in yield with the local variety
		1958–59	922	3·96	57	SRMS	..	..	Experiment is not significant
		Average	787	3·96	57				
9	3 F 10–103	1957–58	633	4·04	55	SR	77	158	*At par* in yield with the local variety
		1958–59	1,025	4·20	58	SR	70	135	do.
		Average	829	4·12	56				
10	22 F 9–152	1957–58	269	4·16	59	SR	76	155	*At par* in yield with the local variety
		1958–59	909	4·61	61	SR	..	..	Experiment is not significant
		Average	589	4·61	60				
11	22 F 9–153	1957–58	652	5·10	59	SR Heavy	140	287	*At par* in yield with the local variety
		1958–59	1,005	5·12	59	SR	70	136	do.
		Average	828	5·11	59				
12	5 F 9–155	1957–58	256	4·19	56	SR	76	155	*At par* in yield with the local variety
		1958–59	1,030	4·36	56	SR	70	136	do.
		Average	643	4·27	56				
13	9 F 9–186	1957–58	602	3·62	58	SR	94	192	*At par* in yield with the local variety
		1958–59	960	4·00	59	SR	70	136	do.
		Average	781	3·81	58				

* Rust reactions as observed at the Agricultural Research Station, Mahabaleshwar, under conditions of heavy infections of rust.
The letters denoted for rust reactions are specified below:—
RSR .. Resistant to semi-resistant;
SR .. Semi-resistant.
SR Heavy .. Slightly heavier infection than SR.
SRMS .. Semi-resistant to mildly susceptible.

TABLE II

Ancillary Data on Plant Spike and Grain Characters of Promising Rust-Resistant Wheat Cultures

Sl. No.	Cultures	Height of plant in cm. (Average of two seasons)	Average of two seasons (1957–58 and 1958–59)				Grain Size and Colour
			Effective No. of tillers per plant	Spike length in cm.	No. of spikelets per spike	Dry spike colour	
1	2	3	4	5	6	7	8
1	3 F 13–1	67·1	6·7	6·5	15·6	Br. G. Br.	Bold red
2	3 F 12–27	63·8	5·5	6·1	13·9	,,	Bold deep red
3	3 F 12–30	72·8	6·3	6·7	15·6	,,	Medium lustrous red
4	3 F 12–52	73·4	8·6	7·2	15·4	W. G. W.	Bold long lustrous red
5	3 F 10–76*	88·9	12·9	6·0	14·9	,,	Medium lustrous red
6	3 F 10–77	70·4	6·8	6·8	15·4	Br. G. Br.	Bold lustrous red
7	3 F 10–78*	77·6	9·1	6·8	14·4	,,	Medium lustrous red
8	3 F 10–79*	87·6	9·8	6·7	15·8	,,	do.
9	3 F 10–81	71·5	5·7	7·0	14·9	,,	Medium plumy lustrous red
10	3 F 10–82	69·8	5·8	5·9	14·3	,,	Medium lustrous red
11	3 F 10–83	63·3	7·0	6·2	14·8	,,	do.
12	3 F 10–95	71·4	7·7	6·4	15·6	,,	Bold long lustrous red
13	3 F 10–102	62·9	7·2	6·0	14·1	,,	Medium lustrous red
14	3 F 10–103	70·3	8·6	6·4	15·8	,,	do.
15	22 F 9–152	59·6	5·2	5·9	14·0	,,	Medium amber red
16	22 F 9–153	65·6	6·5	6·2	14·7	,,	Bold lustrous red
17	5 F 9–155	56·9	5·9	5·4	13·7	W. G. W.	Medium lustrous red
18	9 F 9–186	73·8	5·9	6·0	14·1	,,	Medium plumy lustrous yellow
19	Local ..	58·5	7·5	6·4	14·2	W. G. W. & Br. G. Br.	Medium lustrous red

* Average for one season only.

Acknowledgements

Thanks are due to Mr. N. B. Kajjari and others who had initiated the work reported herein.

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PRELIMINARY INVESTIGATIONS ON THE EFFECT OF DIFFERENT DATES OF SOWING OF PADDY (*ORYZA SATIVA* L.) ON SOME OF THE YIELD CONTRIBUTORY CHARACTERS

By C. Kempanna*

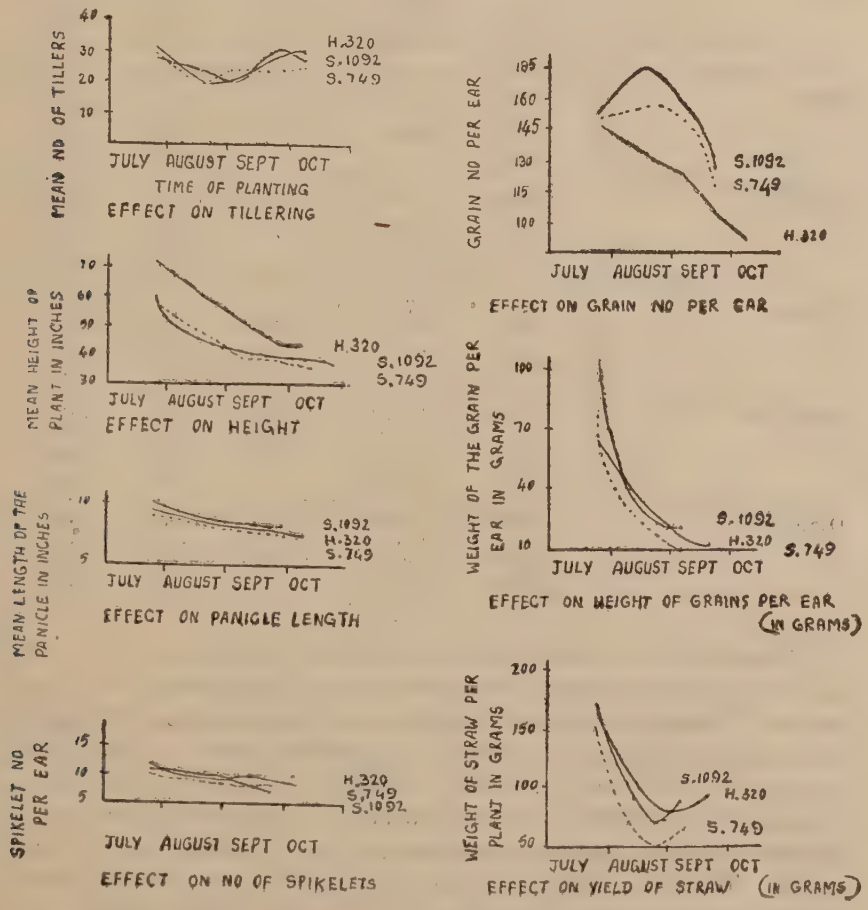
Rice, the first cereal food crop of the world's majority of the population is cosmopoliton in its habit of growth. "Rice", states Pendleton (quoted by Grist, 1953) "is doubtless the most adaptable Food Crop man grows, and if enough water remains on the soil until the maturing of crop, it can produce at least a little grain on soils that are unbelievably poor in plant nutrients". Its readily adaptable nature to varied environment conditions resulted in the production of rich diversity of forms which are under cultivation in various rice-growing regions of the world. Despite such a vast genetic diversity the output per acre remains to be low in most of the rice-growing tracts particularly in India. The major factors contributing towards the increase in yield are (*a*) a variety with good heritable potentiality, (*b*) systematic agronomic practice and (*c*) prevalence of congenial weather conditions. The importance of the last factor besides the first two can in the least be underestimated. Low yield may also be the consequence of growing a variety otherwise good with heritable potentiality for yield in an entirely unsuitable season. Therefore, the necessity for the study of the development of the plant in all its phases with reference to environment and for fixing up of an optimum time of sowing of varieties for derivation of maximum benefit needs no emphasis as it is the only direct method of approach to the yield problem. This article embodies the results of such investigations as conducted at the Agricultural Research Station, Hebbal, Bangalore, during the monsoon season of 1957, on three important, improved varieties of paddy which are under large-scale cultivation in Mysore State.

Material and Methods

Three varieties, *viz.*, Hunisehuvinabatha (H. 320), Rathna Choody (S. 749) and Bangarakovi (S. 1092) were chosen for the study. The nurseries were sown and the seedlings from respective sowings were

* Botany Division, Agricultural College, Hebbal, Bangalore-6.

transplanted in the puddled field on the dates noted in Table II. Usual agronomical practices including the application of organic and inorganic manures that were followed in the region were accorded. The spacing between the lines and within the line was one foot and nine inches respectively. All the five sowings were replicated 4 times in a simple randomised replicated block. Each variety in each replication was planted in 4 rows of 10 feet each. Six plants per variety in each replication were selected for observation. The yield of grain and straw of each individual plant was recorded when they were fresh and 1,000 grain weight was taken after drying the seed since the same could not be attended to immediately after the harvest of the crop. The meteorological data quoted here was based upon the daily observations at the Meteorological Observatory of the Agricultural College, Hebbal. Data are represented graphically also.


MEAN NO OF TILLERS
H.320
S.1092
S.749
JULY AUGUST SEPT OCT
TIME OF PLANTING
EFFECT ON TILLERING
MEAN HEIGHT OF PLANT IN INCHES
EFFECT ON HEIGHT
MEAN LENGTH OF THE PANICLE IN INCHES
EFFECT ON PANICLE LENGTH
SPIKELET NO PER EAR
EFFECT ON NO OF SPIKELETS
GRAIN NO PER EAR
EFFECT ON GRAIN NO PER EAR
WEIGHT OF THE GRAIN PER EAR IN GRAMS
EFFECT ON WEIGHT OF GRAINS PER EAR (IN GRAMS)
WEIGHT OF STRAW PER PLANT IN GRAMS
EFFECT ON YIELD OF STRAW (IN GRAMS)

Experimental Results

Prevailing weather conditions at the Research Station during the growing period of the crop are recorded in Table I.

Table I

Mean temperature (F.°), mean percentage of humidity, length of the day, rainfall in inches and mean velocity of wind (mph.) recorded at the Agricultural Research Station, Hebbal, Bangalore

Month	Week	Temp. °F.	Humidity (%)	Length of the day Hrs. Mts.	Velocity of wind (mph.)	Rainfall (in inches)
July ..	I	75·02	78·10	12–51	12·54	0·45
	II	74·55	90·00	12–48	12·25	0·33
	III	74·28	87·80	12–45	11·79	0·09
	IV	73·82	89·10	..	8·57	0·12
August ..	I	74·12	84·10	12–40	9·39	0·43
	II	72·15	87·80	12–34	9·58	0·63
	III	75·66	89·40	12–29	11·80	0·24
	IV	75·27	83·70	..	10·80	0·04
September ..	I	74·17	84·10	12–22	6·66	0·08
	II	72·15	87·80	12–16	8·10	0·55
	III	75·66	89·40	12–9	6·14	0·14
	IV	75·27	83·70	..	3·49	0·00
October ..	I	74·15	77·60	12–2	4·48	1·73
	II	75·65	90·50	11–56	3·63	0·28
	III	74·77	89·20	11–48	5·52	0·30
	IV	74·40	91·50	..	4·53	0·86
November ..	I	72·45	93·10	11–42	5·60	0·39
	II	77·27	93·00	11–37	5·54	0·79
	III	72·44	90·20	11–32	4·63	0·00
	IV	69·93	91·20	..	4·89	0·00
December ..	I	69·63	92·00	11–28	5·06	0·00
	II	69·62	93·50	11–25	4·86	0·00
	III	69·77	88·70	11–25	5·64	0·00
	IV	69·96	89·10	..	5·91	0·00

Temperature during the growth period remained more or less uniform up to third week of November and then below 70° F. was noticed. Though, considerable variation in the percentage of humidity from week to week was noticeable, it remained to be more than 90% during November and December months. Variation in day length ranged from 12 hours 51 minutes in July to 11 hours 25 minutes in December with a gradual declination of 5 to 8 minutes per 10 days' period. The wind velocity was more during July and August months as those two months were naturally connected with heavy wind. Low wind velocity was obvious in the rest of the period except during first

half of November when it slightly increased. There was a total rainfall of 7·43 inches during the growing period from July to November and it was more or less uniformly distributed.

Though the difference in dates of sowing between the first and the second sowings was 25 days and difference between the first and the third was 40 days, both flowered only at an interval of about 15 days (Table II). The reduction in the vegetative period of second and third sowings, particularly the latter, was quite apparent. The fourth and fifth sowings in all the three varieties, either flowered unevenly or not flowered, vegetative phase continued and the crop was not harvested at all.

In a reference to Table III, it is clear that the varieties, H. 320 and S. 1092 showed significant differences in their tiller number between sowings and though, the differences were not significant in S. 749,

TABLE II

Date of sowing nursery, Date of transplanting, Date of flowering, Date of harvest, Number of days taken by each phase

Variety and treatment	Date of sowing nursery	Date of transplanting	Date of flowering	Date of harvest	No. of days in nursery	No. of days to flower
H. 320 S 1	20—6—1957	25—7—1957	6-11—1957	9—1—1958	35	103
S 2	15—7—1957	20—8—1957	16-11—1957	21—1—1958	35	86
S 3	1—8—1957	5—9—1957	20-11—1957	28—1—1958	34	75
S 4	15—8—1957	22—9—1957	24-11—1957	Not harvested	37	62
S 5	2—9—1957	10-10—1957	Irregular flowering	do.	37	..
S. 749 S 1	20—6—1957	25—7—1957	1-11—1957	9—1—1958	35	97
S 2	15—7—1957	20—8—1957	12-11—1957	21—1—1958	35	82
S 3	1—8—1957	5—9—1957	16-11—1957	28—1—1958	34	71
S 4	15—8—1957	22—9—1957	Irregular flowering	Not harvested	37	..
S 5	2—9—1957	10-10—1957	Not flowered	do.	37	..
S. 1092 S 1	20—6—1957	25—7—1957	3-11—1957	9—1—1958	35	100
S 2	15—7—1957	20—8—1957	14-11—1957	21—1—1958	35	84
S 3	1—8—1957	5—9—1957	18-11—1957	28—1—1958	34	73
S 4	15—8—1957	22—9—1957	Irregular flowering	Not harvested	37	..
S 5	2—9—1957	10-10—1957	Not flowered	do.	37	..

differing trends of the tiller number was evident from the data. S 2 and S 3 in all the varieties produced less tillers than S 1, S 4 and S 5.

Though the differences in the height of the plant in all the varieties between the sowings were not significant, gradual reduction from S. 1 to S 5 could not be ignored.

The differences between the sowings in S. 749 and S. 1092 so far as the panicle length was concerned were significant while it was not so in H. 320. Nevertheless, the gradual declination even in H. 320 was perceptible.

All the varieties in their spikelet number per year differed significantly, S 1 being the highest and S 5 the least.

TABLE III

Date on yield attributes

Variety and treatment	No. of tillers per clump	Height of plant in inches	Length of the panicle	No. of spikelets per ear	No. of grains per ear	Yield of grain per plant (gm.)	Yield of straw per plant (gm.)
H. 320 S 1	31·50	68·75	9·62	12·15	149	68	174·6
S 2	20·50	59·50	9·20	10·00	131·2	32·00	81·69
S 3	22·50	52·00	8·32	10·06	126·0	15·00	79·50
S 4	31·00	45·00	7·97	9·70	105·2	14·00	92·50
S 5	33·75	43·25	7·75	8·43	90·0	Not harvested	Not harvested
C.D.	8·60	Not significant	Not significant	0·40	Not significant	19·00	26·80
S. 749 S 1	29·25	53·25	9·32	10·76	151·15	78·00	155·0
S 2	22·25	45·00	8·95	9·78	160·24	20·30	50·8
S 3	21·75	39·25	8·35	8·43	149·13	10·00	67·0
S 4	34·75	39·50	7·80	9·57	115·30	Not harvested	Not harvested
S 5	33·25	34·50	Not flowered	Not flowered	Not flowered	do.	do.
C.D.	Not significant	Not significant	0·872	1·82	Not significant	17·93	64·94
S. 1092 S 1	29·25	55·50	9·85	11·06	155·3	103·0	177·0
S 2	22·25	39·75	9·80	10·27	190·20	34·40	70·1
S 3	21·75	47·00	8·80	9·98	151·14	17·10	79·1
S 4	34·75	40·50	8·00	7·94	121·95	Not harvested	Not harvested
S 5	33·25	40·75	Not flowered	Not flowered	Not flowered	do.	do.
C.D.	6·60	Not significant	0·741	1·17	Not significant	20·45	70·00

Though differences between sowings in all the varieties so far as mean number for grains were concerned were not significant, lowering results was noticeable.

The differences in the yield of the grain per plant in all the varieties were highly significant. The third sowing suffered very badly on account of several adverse weather factors and prevalence of diseases and pests. Marked reduction in the grain weight from S 1 to S 3 was due to heavy chaff besides the proportionate reduction in the development of the yield characters. In the yield of straw also significant differences were recorded. Lesser straw weight in S 2 and S 3 than in S 1 is supposed to be due to reduction in the number of tillers and reduction in the height of the plant recorded in those sowings.

The differences between the sowings so far as 1,000 grain weight was concerned were not significant. This was perhaps due to selection of well-developed grains for weighing after the chaff was completely winnowed.

From Table IV, it is clear that the incidence of the disease like Blast and Brown spot was severe on third and subsequent sowings. Ephelis was present only on S. 749 and its moderate attack was noticeable on all the sowings. The stem-borer attack was more conspicuous on the third and the later sowings than on the earlier sowings. Variety H. 320 lodged invariably in all the sowings while the other two varieties lodged only in the first sowing and was standing in the subsequent sowings. Percentage of chaff was more in the third sowing than in the second and first sowings. Fourth and fifth sowings were not harvested as the crop growth was not satisfactory, on account of prolonged vegetative phase and uneven flowering.

Discussion

The outstanding work of Engledow and his associates on the study of fundamentals underlying the development of the plant and consequences on yield in cereals, enlightens our knowledge about the influence of external factors on the developmental characters. According to Grist (1953), there is probably no important cereal crop that is more influenced by environment than paddy. The examination of results from the present investigation seems to justify Grist's statement.

Effect of different dates of sowing on duration.—Amongst various physiological characters of the rice plant ' duration ' or the period taken by the plant to complete its life-cycle from the time of germination to the time of development of the seed is very important. There are three definite periods of growth: (1) nursery period, (2) period from transplanting to flowering and (3) ripening period. According

TABLE IV

Incidence of Blast, Brown spot, Ephelis diseases and Stem-borer of paddy, Lodging, and chaff position in different varieties under each sowing

Variety and treatment	Blast	Brownspot	Ephelis	Stem borer	Lodging	Chaff
H. 320 S 1	Nil	Nil	Nil	Moderate	Badly	Little
S 2	Moderate	Moderate	,,	,,	Lodged	Moderate
S 3	Severe	Severe	,,	Severe	,,	Heavy
S 4	,,	,,	,,	,,	,,	,,
S 5	Due to uneven flowering the crop was not harvested					
S. 749 S 1	Nil	Nil	Present	Moderate	Lodged	Little
S 2	Moderate	Moderate	,,	,,	Not lodged	Moderate
S 3	Severe	Severe	,,	Severe	,,	Heavy
S 4	The crop was not harvested on account of prolonged vegetative phase and irregular flowering					
S 5						
S. 1092 S 1	Nil	Nil	Nil	Moderate	Lodged	Little
S 2	Moderate	,,	Moderate	Nil	Not lodged	Moderate
S 3	Severe	Severe	,,	Severe	,,	Heavy
S 4	The crop was not harvested on account of the rearons stated above					
S 5						

Little = 10%; Moderate = 20%, Severe = 50% and above.

to Ramiah (1953), of the three periods, the second one is the most affected by changes in climate, season, soil or cultural treatment if there are any. Observations from the present experiment on this aspect are in full agreement with those of Ramiah. Depending upon the reaction of rice varieties to different dates of sowing, they are classified into two categories: (i) those which are time-limited called " period-bound ", *i.e.*, varieties, which, irrespective of their time of sowing or transplanting come to harvest by taking more or less the same period and (ii) those varieties which are season-limited or " Season-bound ", come to harvest at a particular season of the year with a slight variation irrespective of the time of sowing (Chakravarthy, 1937 and Ramiah, 1953). Flowering

of all the three varieties in the first three sowings more or less at the same period with a slight variation during first three weeks of November as seen from Table II, irrespective of their time of sowing, establishes, beyond doubt, their season-bound nature. The observations of Ramiah and Eussian workers (as quoted by Ramiah, 1953), that the duration is dependant upon the photoperiodic response of the rice varieties even to a slight change in the day length in tropics, is found to be true in the present case in which all the three varieties have responded equally to the slight change in day length ranging from 12 hours 51 minutes in July to 11 hours 25 minutes in December with a gradual declination of 3 to 8 minutes per 10 days' period (Table I) and changed their duration to flower more or less at the same period irrespective of their date of sowing. The response of the varieties to photoperiod effect to change their duration is further evidenced by the fact that they are long duration varieties and the long duration varieties are said to be influenced more than the short duration varieties by the change in day length (Ramiah, 1953).

Effect of different dates of sowing on Tillering.—Most important amongst the morphological and physiological characters which contribute considerably to the yield is tillering. By a reference to Table III, it is made out that the first and the last two sowings produced large number of tillers as compared with second and third. According to Ramiah and Narasimhan (1936), Chakravarthy (1938), and Grant and Aung (1941), tillering starts two weeks after transplanting and will be in full swing three to six weeks thereafter, during which period maximum number of tillers are formed. The short duration varieties in order to complete their life-cycle in a short period pass rapidly through the different stages of growth without any interval between the completion of one stage and onset of the other. While the long duration varieties have a slow growth period and there is an interval between the completion of tillering phase and starting of flowering phase, the length of the interval varies with the duration of the variety. There is a justification in recording the large number of tillers in the first sowing as it passed through all the stages of growth normally with a least interference by the external vagaries. But, poor tillering in second and third sowings is largely attributable to the probable overlapping of tillering and flowering phases caused by the curtailment in vegetative phase of the varieties as they are season-bound. More tillers, prolongation of vegetative phase, irregular flowering, large number of abortive tillers and unsatisfactory harvest of fourth and fifth sowings are presumed to have been the consequences of even the normally dormant buds becoming active on account of late planting and cooler climate prevailing during the growing period of these two sowings as late planting and cooler climate are known to cause all these abnormalities (Ramiah, 1953).

Effect of different dates of sowing on height.—Height being the external manifestation of the vigour is an important character of plants. A moderate height combined with good quantity of grain is desirable. Data from Table III, reveal that the differences between the sowings so far as mean height of the plant is concerned in all the varieties are not significant. However, gradual reduction in the mean height of the plant is perceptible. In short duration varieties growth is rapid and continuous, whereas in the long duration varieties growth is slow in the beginning and rapid as the plant advances in age to attain maximum height (Ramiah, 1953). Shortening of duration of otherwise long duration varieties and consequently flowering of the varieties just when they are supposed to be in active growth stage are the probable causes of hindrance to the attainment of maximum height in the late-sown crop.

Effect of different dates of sowing on length of the panicle.—Length of the panicle is a variable factor and has a definite relationship with yield. Significant differences between the sowings in two varieties and the declining trend in the other variety as seen from Table III, confirms, that this character is influenced by different dates of sowing. According to Grant and Aung (1941), the panicle length of main stem and tillers formed earlier are longer than those of the tillers formed late ; and it is believed that the same factor which is responsible for shorter panicle length in Grant's experiment might have prevailed upon the late-sown crop of these varieties to cause shorter panicles.

Effect of different dates of sowing on spikelet and grain number per ear.—The density of the ear depends upon the number of spikelets and grains and on the nature of their arrangement on the panicle. Significant differences between sowings in spikelet number and gradual reduction in grain number from one sowing to the next of all the varieties as seen from Table III are evidences of these characters being influenced by environment. Grant and Aung (1941), observe that the density of the ear was much less in the late-formed tillers than in the early-formed tillers. Probably, the same factor might have operated on the late-sown crop of these varieties too, to bring down the number of spikelets and grains in an ear.

Effect of different dates of sowing on lodging.—Lodging causes considerable loss in cereals if it occurs just at the time of or after flowering period. It renders good varieties useless for cultivation. The causes for lodging can be classified into two categories, *viz.*, (i) the interaction of those hereditory and environmental factors which contribute towards the formation of the weak stem which ultimately cause lodging and (ii) purely external factors such as mechanical impact, due to violent wind at the time of heading. As per Marcarelli quoted by Copeland

(1924), cold weather at the time when tillering should be active checks root development and later results in lodging. Mendiola (1926) believes that variability in wind exposure and depths of water during growing period influences lodging. Ramiah and Mudaliar (1934) opine that the lodging is considerably variable. Both hereditory and environmental factors seem to have caused lodging either acting independently or in combination in the present investigation. From Table IV it is seen that H. 320 in all the sowings irrespective of its time of sowing lodged and this establishes its most susceptible nature to lodging which is perhaps hereditory. The lodging of other two varieties in the first sowing and non-lodging in the subsequent sowings disclose the action of both hereditory and environment. Lodging of these two varieties in the first sowing is probably due to the cooler climate prevailing during the later part of growth period of this sowing which might have checked the proper development of the root and such weak-rooted plants on being exposed to heavy wind velocity of nearly 5 to 6 miles per hour coupled with rainfall during the first three weeks of November (Table I) when the crop was in full bloom.

Effect of different dates of sowing with reference to diseases and pests.—Another factor in relation to yield characters which is of considerable importance, is the incidence of diseases and pests. Notable amongst several rice diseases which were in a severe form were Blast, Brown-spot and Ephelis and amongst pests paddy Stem-borer only. It is evident from Table IV, that the incidence of Blast and Brown-spot diseases was very severe on all the varieties on third and subsequent sowings and that of Ephelis was only on S. 749. The first two sowings were either free or attacked moderately by Blast and Brown-spot diseases. According to Hemmi and Abe (1931), Abe (1933) and Anderson *et al.* (1947), a continuous period of wetting of the leaf for over 10 hours at a temperature ranging from 70° F. to 80° F. and over 92% of atmospheric humidity are optimum conditions for the infection of the Blast disease to take place. Nisikado (1923), Katsura (1937), Page, Shert and Morgan (1947), report that the minimum requirements of temperature, humidity and wetting of the leaf for the Brown-spot disease to outbreak are 72° F. (Table I) prevailing throughout the growing period which was not congenial for the development of these diseases must have been the cause for first two sowings to escape the infection by these diseases. Increase in humidity to more than 90% and intermittent rain coupled with high wind velocity (Table I) during latter half of October, November and December months have provided optimum conditions for the infection of the diseases to take place on the late-sown crop. Infection of Ephelis only on S. 749 is attributive to the susceptibility of that variety.

So far as the stem-borer is concerned there are two generations of the pest in a year, one from June to July and the other from September to October. It is said that the pest will be more active during the second period than that of first. The synchronisation of the second generation of the pest with the active growth stage of the late-sown crop is perhaps the reason for the heavy attack of the pest on these sowings as against moderate attack on early-sown crop (Puttarudriah and Appanna, 1956).

Effect of different dates of sowing on yield.—Of all the characters hitherto studied, yield is probably the most complex phenomena. It is determined by certain physiological processes occurring during the course of development of the plant. Significant differences in yield of both grain and straw, as seen in Table III, are the results of large number of factors, both genetical and environmental. The important environmental condition that affected the yield character is observed to be the time at which the crop flowers (Ramiah, 1931). Heavy rainfall or dry condition of the soil at the time of and just before the flowering phase are stated to cause large number of sterile spikelets. Japanese workers quoted by Ramiah (1953), observe that the rain affects the air temperature and it is possible that low air temperature with high humidity are the primary causes for the sterility. Rainy weather in some cases seem to have caused the sterility but no definite correlation between the two is observed by Alam (1936). Tippet (1926), observes that the pollen may be killed at low temperatures in cereals which do not destroy other portions of the plant. Akemine and Hoshika (1939), studied the effect of environment on sterility by growing 32 varieties of rice over a period of fourteen years and found a high negative correlation between air temperature and percentage of sterility, the temperature 1 to 20 days before heading time having a greater influence than the temperature at other periods. Ramiah (1953), reports under the conditions in India, the crop is seldom successful where the mean temperature during growing season is less than 75° F. Percentage of humidity higher than 84 increased the amount of sterility. Longer sunshine had a good effect in reducing sterility. Taylor (1927), Singh and Alam (1944), recorded poor yields in wheat in delayed-sown crops. Anantha Rao *et al.* (1956), observed that sowings done too late tend to decrease yield as a result of lower dry matter production per plant due to the slowing down of vegetative activity brought about by low temperature with the onset of winter in wheat. High fertility of the soil which makes the crop lodge just at the time of flowering, was also shown to result in high percentage of abortive spikelets. Besides all these, infection of diseases and pests cause deterioration in yielding ability of the crop. " It is essential to clearly understand " as Jacobson points out (quoted by Ramiah, 1953) " that tillering, number of grains per ear and yield

are elastic and compensating characters. Each in turn is affected by the one preceding it and the development of the character is extended or curtailed by the prevailing environmental conditions and is based upon the extent of the development of the preceding character". All the factors cited above must have had the cumulative effect either directly or indirectly in regulating the development of yield characters and finally attributing on yield in the present investigations.

The varieties did not differ in their 1,000 grain weight under different sowings which may be probably due to selection of only well-developed grains for weighing after removing the chaff completely.

From the results of present investigation and also from foregoing discussion on the effects of different dates of sowing on various yield attributes, it is apparent that all the yield contributary characters have been affected in one way or the other and finally contributed to the low yield. Fluctuations in some of the climatic factors like day length, temperature, humidity, velocity of wind and occurrence of periodical rain during the growth period of the crop have profoundly influenced to bring down the duration, to vary in the development of most of the yield characters, to prolong vegetative phase, to flower unevenly and to cause unsatisfactory harvest.

Therefore, it is possible that the crop sown in June and planted early July will be less subject to these climatic fluctuations as compared with those sown later. The information on the effect of sowing earlier than middle of June and that of sowing the crop throughout the year later than first week of August would have been an adjunct to this, but, inadequacy of water from the tank for irrigation throughout the year and lack of other facilities are limiting factors to undertake such type of studies in this Research Station.

Summary

1. A trial with three improved, long-duration varieties, *viz.*, H. 320, S. 749 and S. 1092 was conducted during 1957 with a view to find out the effect of different dates of sowing on various yield attributes and also to ascertain the probable optimum period of sowing for these varieties to derive maximum benefit.

2. The effect of different dates of sowing is so apparent as to bring down the duration of the varieties which is probably due to the photoperiodic response of the varieties to the change in day length. It is concluded that the varieties are season bound.

3. Variation in tiller number is supposed to be due to overlapping of tillering and flowering phases consequent upon the reduction in duration of the varieties and also to the normally dormant

buds becoming active and producing tillers on account of late planting and cooler climate prevailing during the growth period.

4. Height, panicle length, spikelet and grain numbers per panicle have also been discussed to be not exceptional to the action of environment.

5. Lodging in H. 320 is attributive to its susceptibility to lodging and that of other two varieties in the first sowing only, is concluded to be due to violent wind prevailing at the time of flowering and also to cooler climate which has probably hindered the root development and consequently resulted in lodging.

6. Severe outbreak of Blast and Brown-spot diseases only on third, fourth and fifth sowings are traced to be due to the prevalence of optimum climatic conditions for the infection of the disease during the growth period of these sowings. Appearance of Ephelis only on S. 749 is assumed to have been due to the susceptibility of that variety to the disease.

7. Severe attack of paddy stem-borer on third, fourth and fifth sowings only are discussed to be due to the synchronisation of growing period of these varieties with the second generation of the pest during September to October when the activity of the pest is said to be more.

8. Yield is a complex of all the characters and dependent upon large number of factor both genetical and environmental. Hindrance to the development of one character is an hindrance to the development of the other and consequently pronounces on the yield. Large number of environmental factors like reduction in day length, temperature, high humidity, voilent wind, intermittent rainfall during flowering period influenced the development of yield attributes to result in the reduced yield.

9. Finally, it is concluded that the crop sown during 2nd or 3rd week of June and transplanted in July is less likely to be subjected to climatic changes and hoped to give satisfactory yield.

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BLAST ON RICE IN MYSORE

Fungicidal Treatment of Rice Seeds

By N. S. Venkatakrishniah* and M. H. Dely*

Of the important diseases affecting rice in Mysore the worst disease is blast caused by *Piricularia oryzæ* Cav. The disease is observed throughout the State. It causes severe loss in important rice-growing tracts in Mysore.

Infection is noticed on seedlings in the nursery. Presence of conidia and mycelium of the pathogen is observed on the seed, glumes, necks, straw and stubbles in the field. Infection is also found on other wild grasses, chiefly on two species of *Panicum* in the vicinity of rice fields in Mysore.

The infection is reported to be seed-borne in Japan. Tisdale[8] isolated the fungus from seed. Dudoff and Kovanca-Vski[1] state that the pathogen overwinters as conidia on rice seeds, on straw and stubble, Schultz[6] reports that the fungus overwinters in soil and is carried to wild grass, *Panicum sanguinale.*

Several collateral hosts of the pathogen have been recorded in South India. Infection is observed on *Panicum repens, Digitaria marginata, Dinebra retroflexa, Setaria intermedia* and on two other species of *Panicum.* They serve most probably as sources of infection in Nature.

In Mysore glume infection of rice is very common. But direct transmission of the disease through seed tried in the laboratory at Bangalore under artificial methods have not been so far successful. Experiments carried out at Coimbatore[3-10] have also failed to show that the disease is seed-borne.

Different methods of seed treatment have been tried by several workers to control the disease. Nishikado and Miyake according to Orton[4] failed to control the pathogen by hot water treatment. They regard that the fungus is not seed-borne. Suzuki[7] in his studies on the possibility of primary infection through seed suggests hot water treatment of seeds at 50° C. Ito[2] states that the conidia of the fungus on the seed are killed when frozen in water. Tuteffe[9] advocates seed treatment with Kalimat.

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In Assam[5-13] fungicidal treatment of seeds improved the germination of seed and increased the crop yield. In Hyderabad[12] treatment of seed with Agrosan G.N. gave the least infection by blast. Similar seed treatment trials conducted in Cuttack[11] at the Central Rice Research Station did not give any beneficial results.

In Mysore, treatment of seeds with Kalimat B. was tried in 1933–34 by the senior author.[14] The seeds were treated with 0·2% solution for 24 hours and sown after drying. The plants did not show infection by *Piricularia*. Further trials were conducted in later years 1944–47 with monohydrated copper sulphate and Ceresan dry and wet at the Government Central Farn, Hebbal and at the Paddy Breeding Station, Nagenahally. The seed treatment with monohydrated Copper Sulphate reduced the incidence of infection and gave a slightly higher yield than the control. Treatment of soil by way of rabbing the seed-beds, by application of Tobacco waste and kainite to the field was tried during 1943–45 at the Paddy Breeding Station, Nagenahally. It had no effect either in reducing the incidence of infection or in increasing the yield of crop. Infection was heavier in the plots treated with kainite and tobacco waste and on plants raised from rabbed beds. Further trials were conducted during the years 1956–59, on a field scale in a heavily infected area near Channapatna in Bangalore District. The straw and stubbles left in the field after harvest were dusted before ploughing with fine sulphur dust and Ceresan-lime dust at the rate of 10–15 lb. per acre. The crop was raised after treating the seeds with Agrosan G.N. The treatments gave remarkable control of the disease and appreciable increase in yield of the crop. This indicates that the chief source of infection is through the conidia overwintering on the grain, stubbles and straw remaining in the field.

Methods and Material

Seed-treatment trials with new fungicides were further conducted at the Agricultural Research Station, Hebbal, near Bangalore and at the Paddy Breeding Station, Nagenahally, near Mysore, with a view to note the comparative effect of the several treatments on the germination, on the incidence of infection and on the yield. The following fungicides were used during the trials from 1953 to 1957.

1. Agrosan G.N.	An organo mercurial dust at 4 oz. in 112 lb. seed	
2. Special Agrosan	do.	do.
3. Ceresan dry	do.	do.
4. Ceresan wet	do.	0·1% solution
5. Tillex dry	do.	4 oz. in 112 lb. seed

6. Fernasan A.	A non-mercurial organic fungicide	at 4 oz. in 112 lb. seed fungicide
7. Copper Sandoz	A cuprous oxide preparation	at 1 lb. in 25 gallon water
8. Yellow cuprocide (Y.F. 2776)	do.	1 lb. in 100 lb. seed
9. Copper seed dressing	do.	do.
10. Fermate	An organic fungicide based on Ferric dimethyl dithio carbamate	at 4 oz. in 112 lb. seed
11. Non-mercurial seed dressing		at 4 oz. in 112 lb. seed

S. 705 seed rice was selected for the trial. This was observed among the local varieties to be highly susceptible to blast infection. Co. 13 rice which is also highly susceptible to blast under Mysore conditions was also included in the experiment for one year. Necessary conditions were provided for inducing the disease by the application of higher dose of manure than the normal dose and by late planting both in the nursery and in the field. Nitrogen was applied in the form of green manure, compost and ammonium sulphate at 80 lb. per acre. The fungicides were applied in the form of dust except Ceresan wet and Copper Sandoz which were applied in solution. The seeds were dried well and mixed thoroughly with the requisite quantity of the fungicide in large-sized airtight glass-stoppered bottles. The seeds were well-coated with the fungicidal dust. They were stored in the bottles for one week before sowing. The seed rate was uniform throughout. They were sown on raised beds of $6\frac{1}{2} \times 4\frac{1}{2}'$ each, in a randomised block design, replicated 5 times. Counts were taken 15 days after sowing in 5 different places each of 6″ square in each nursery bed for germination and for seedling infection (Table I). Seedlings from each nursery bed were transplanted to the corresponding field plots of 1/40th an acre each, maintaining the same design as in the nursery. An approximate area of the seedlings required from each nursery bed for transplanting the corresponding field plot was noted (Table I). The incidence of infection by blast was noted in the nursery before transplantation and in the field before the flowering stage of the crop. Five lots of 50 leaves each were collected at random from 5 rows in each plot. They were sorted out into 4 grades healthy, light, medium and heavy according to the intensity of spotting on the leaves as compared with an illustrated infection grading chart. The neck infection was noted by collecting 5 samples at random in each plot. Each sample contained 100 culms with earhead. They were sorted out into healthy and

infected necks. The yeild of grain was noted for each individual plot (Tables I and II).

TABLE I

Effect of Seed Treatments (Var: *S.* 705) *at the Agricultural Research Station, Hebbal, for three years,* 1953–56.

Sl. No.	Treatments	Germination-total No. of seedlings in 25 Sq. of 6″ each			Total area in Sq. Ft. of the seedlings in the nursery beds required for transplantation			Total yield of grains in pounds per acre		
		1953–54	1954–55	1955–56	1953–54	1954–55	1955–56	1953–54	1954–55	1955–56
1	Control ..	742	1229	1739	109	115·6	62·5	1672	2304	1432
2	Agrosan G.N.	1052	1314	1770	101	110·0	59·0	1720	2400	1552
3	Special Agrosan	856	1142	1699	108	119·6	63·5	1736	2296	1592
4	Copper seed dressing	950	1268	1522	112	115·3	66·2	1992	2368	1512
5	Fernasan A. ..	761	1446	1692	112	112·5	61·0	1832	2424	1472

TABLE II

Effect of Seed Treatments at Paddy Breeding Station, Nagenahally for 1956–57

Sl. No.	Treatments	Germination-total No. of seedlings in 25 Sq. of 6″ each	Total area in Sq. Ft. of the seedlings in the nursery beds required for transplantation	Total yield of grains in pounds per acre
1	Control ..	2283	84·5	1625
2	Agrosan G.N. ..	2759	83·0	1768
3	Ceresan dry ..	2386	78·9	1618
4	„ wet ..	2429	80·0	1625
5	Tillex dry ..	2551	75·5	1755
6	Copper Sandoz ..	1968	89·0	1664

RESULTS

The percentage of infection even in control plots was low. There was not marked difference in the incidence of infection either in the nursery or in the field. So it has not been included in the tables.

However the percentage of infection in the bulk plots varied from 17 to 22%. The treatment showed increase in the percentage of germination and in yield over the control though not significant, statistically. Treatment of, seed with Agrosan G.N., Fernasan A, Tillex dry, Ceresan dry and wet, and copper seed dressing gave better germination, vigorous growth and better stand of the seedlings in the nursery and higher yield than the control. Treatment of seed with Fermate, non-mercurial seed dressing, Yellow cuprocide and Copper Sandoz was tried for two years 1954 to 1956 at the Paddy Breeding Station, Nagenahally near Mysore. They did not indicate any beneficial result.

Summary

The experiments conducted indicate that the fungicidal treatment of rice seeds give marked improvement in germination of the seeds, better stand of the seedlings in the nursery and higher yield of the crop than the control. The chief source of infection is through the conidia observed on the stubble, straw and grain left after harvest in infected fields apart from the pathogen carried on collateral hosts (wild grasses) in the area. Treatment in the field of stubbles, straw and grain after harvest and before ploughing with fine sulphur dust or Ceresan-lime dust controls the spread of the disease to a large extent.

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OBSERVATIONS ON THE BIOLOGY AND HABITS OF *ANTROCEPHALUS* SP., THE PUPAL PARASITE OF *CORCYRA CEPHALONICA* STAINTON

By K. S. Shivashankara Sastry[1] and M. Appanna[2]

Introduction

Corcyra cephalonica St., in recent years, has assumed importance both in the field of fundamental research and Applied Entomology. In the latter, its importance, as Laboratory host, for mass production of *Trichogramma minutum* Riley, has been well established. In the mass cultures of *Corcyra cephalonica*, its pupal parasite, *Antrocephalus* sp. (Chalcidæ, Hymenoptera), is found in numbers. A study on the biology, habits and economic importance, of this parasite in relation to its host was made at Bangalore and Mandya, where mass cultures of *Corcyra* are maintained throughout the year. This note details the observations made.

Thompson (1946) has recorded *Antrocephalus ethiopicus* from Italian Somaliland and *A. mahensis* Masi from India. Krishna Ayyar (1934) records *A. mahensis* as occurring in sufficient numbers in the mass cultures of *Corcyra* and says that its importance in *Corcyra* production has yet to be studied.

Incidence of the parasite in mass culture of Corcyra cephalonica:— The parasites appear in considerable numbers where sufficient *Corcyra* rearing cultures are maintained. When a fresh *Corcyra* culture for 1953 was started in May, the parasite, which existed in considerable numbers during October–December 1952 and January 1953 did not appear till August 1953. Its numbers were built up in subsequent months as shown in Table I.

It can be seen that the percentage of incidence is very small and thus its effect on moth production is negligible.

General Observations on the Habits of the Parasite

The insect.—The adult is fairly big in size (male being smaller than the female) dark in colour with well pronounced coxæ of dark brown to light brown hue, and is capable of short flights and quick movement.

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TABLE I

Table showing the incidence of Antrocephalus *sp., in the mass cultures of* Corcyra cephalonica *sp.*

Period	No. of moths emerged and collected	No. of parasites emerged and collected		
		Females	Males	%
March 1952	9,492	14	35	0·5
April 1952	21,375	13	41	0·2
June 1952	1,64,096	13	110	0·07
July 1952	3,53,595	..	..	Nil
August 1952	3,27,735	..	..	Nil
September 1952	5,12,595	..	..	Nil
October 1952	4,35,700	14	58	0·01
November 1952	3,69,230	47	128	0·04
December 1952	14,500	55	165	1·5
January 1953	11,988	26	40	0·5
May 1953	12,153			1st culture of *Corcyra* for 1953
June 1953	14,742	..	..	..
July 1953	35,349	..	..	..
August 1953	1,11,470	..	5	0·004
September 1953	1,56,813	..	..	Nil
October 1953	3,85,785	17	80	0·02
November 1953	3,57,652	60	17	0·02
December 1953	58,114	3	33	0·06
January 1954	59,541	..	18	0·03
February 1954	24,648	6	37	0·1
March 1954	21,990	6	40	0·2
April 1954	23,212	5	16	0·09
May 1954	1,61,020	1	3	0·003

It, when disturbed, feigns death by folding its legs along the longitudinal axis of the body and remains as such for more than three minutes. Though usually the adults hover in the *Corcyra* rearing cupboards, most of them are drawn towards bright patches of light or to surfaces with white background, and are easily seen in such places in *Corcyra* rearing units.

The incubation period of the egg appears to be 3 days. The young grub is seen in the posteriormost region of the host pupa. The pupal contents get disorganised into a fluidy mass in which the grub lies freely feeding on it. The larval and pupal periods occupy 15–16 and 12–13 days respectively, and the life-cycle is completed in 21–30 days (average 25·3 days).

The adult emerges out by biting a hold through the pupal case and the web of the cocoon. The male generally emerges earlier than female.

Mating.—Mating takes place immediately after emergence. The male holds the female, bursches it with its antennæ, gradually slips down and copulates. The period of courting ranges from 35 to 55 seconds, actual copulation lasting for about 35 seconds.

Oviposition.—Oviposition is followed by a careful search by the female with its antennæ for a suitable point on the web in between the Jowar grain particles sticking to the cocoon. During oviposition it remains parallel to the cocoon either above, or in the same plane as the cocoon and then inserts its conspicuous, well developed ovipositor. The period taken for deposition of the egg ranges from 25 seconds to 3 minutes and 15 seconds (average 1 minute 17 seconds).

Longevity.—The adult female and male lived on an average for 4·4 and 5·2 days respectively with honey as feed.

The fecundity of a mated female ranged from 3–10 (average 6) but only one adult emerges out of a single parasitised cocoon.

Parthenogenesis, though rare, was observed in this species resulting in male progeny only.

Sex-ratio.—The males preponderate over the females, the sex-ratio being male to female: 2·6 : 1 as shown in Table II.

Host preference.—Naked pupæ, which are bereft of the grains are not preferred as a rule. Mature larvæ enclosed in pupal cases (webs) when exposed to the parasites, are stung but are not parasitised. Pupæ which are older than 72 hours are not preferred. These factors qualify the behaviour of the parasite in selecting the host.

TABLE II

Sex ratio of parasites

Culture No.	Females	Males
1	15	24
2	45	68
3	29	71
4	14	35
5	13	41
6	13	110
7	12	11
8	14	58
9	47	128
10	55	165
11	26	40
12	..	5
13	17	80
14	60	17
15	3	33
16	..	18
17	6	37
18	6	40
19	5	16
20	1	3

INFLUENCE OF HOST PUPA ON THE SEX OF PROGENY OF PARASITE

During the course of study it was observed in laboratory cultures that the sex of the progeny was dependant on the nature of the host pupa. A number of trials were set up to study the influence of the host on the progeny of the parasite.

Method.—It was observed that large-sized pupæ gave rise to female moths and the small-sized ones to male moths. Host pupæ of these two categories were mounted on cardboard strips separately and mated female parasite was allowed to parasitise them.

In addition mated female parasites were allowed in enclosures containing *Corcyra* cocoons (mass culture). The pupæ were separated into the two sizes—big and small—, 15 days after the introduction of the parasites and each pupa was kept separately in individual container.

It was observed that mostly female parasites emerged out of the big pupæ while males emerged from the small-sized pupæ. The emergence of parasites of sex other than expected may be attributed to the arbitrary selection of the host pupæ. The following Table III gives the data.

TABLE III

Table showing the influence of host sex on the sex of the progeny

Period	Big-sized pupæ					Small-sized pupæ				
	No. of pupæ provided	No. of pupæ parasitised	No. of moths emerged	No. of parasites emerged Fem.	Mal.	No. of pupæ provided	No. of pupæ parasitised	No. of moths emerged	No. of parasites emerged Fem.	Mal.
August 1950 ..	5	4	1	4	..	7	4	..	..	4
March 1952 ..	5	nil	..	..	..	5	nil	..	..	..
April 1952 ..	5	3	..	3	..	8	2	..	..	2
	6	2	..	1	1	5	2	..	1	1
	5	4	..	4	..	5	3	..	..	3
May 1952 ..	5	3	..	3	..	5	3	..	1	2
November 1953 ..	13	13	..	13	..	5	5	..	..	5
Bangalore	31	31	..	27	4	15	15	..	1	14
			F. M.					F. M.		
April 1954 ..	..	10	15 : 3	1	..	50	4	3 : 10	1	3
(Total 50 pupæ) ..						(total 50)				
March 1955 ..	10	4	3 : 1	3	1	10	4	1 : 5	..	4
(Total 50)	10	4	4 : 1	4	..	10	4	2 : 4	1	3
Bangalore										
April 1954 ..	10	8	2 : ..	6	2	10	6	.. : 3	1	5
November 1954	10	5	1 : 1	5	1	10	6	.. : 4	1	5
January 1955 ..	10	10	.. ..	9	1	10	7	.. : 1	..	7
February 1955 ..	10	8	1 : 1	7	1	10	6	1 : 3	..	6
		100		90	10		71		7	64

These observations indicate the existence of the relationship between the host and progeny of the parasite. Rakshapal (1954) records a lone instance of the influence of the sex of the host on the sex of its parasite progeny, amongst insects, in the case of *Alophora* sp., parasitic on *Bagrada curciferarum* and attributes it to the probable influence of sex hormones of the host on the parasite. Perhaps in the case of *Antrocephalus* a similar phenomenon exists, the sex of the host having a direct influence on the sex of the progeny of the parasite.

CONTROL

To keep the parasite under control in the mass-rearing cultures of *Corcyra*, light traps were set up at regular intervals and the parasites

attracted to them were destroyed. In addition mechanical collection of adult parasites was also resorted to.

Summary

Antrocephalus sp. is recorded parasitising the cocoons of *Corcyra cephalonica* sp. and occurring in considerable numbers particularly during certain seasons.

The life-cycle from egg to adult occupies 21–30 days and the male and female live for 5·2 and 4·4 days respectively with honey as feed.

An interesting phenomenon, probably the second instance in Insecta, where there is a direct relationship between the sex of the host and the sex of the parasite progeny has been observed and recorded.

Acknowledgements

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A NOTE ON RAT CONTROL IN COCONUT NURSERIES

By G. V. B. Naidu*

Introduction

Coconut seedlings were raised in five centres in the Mysore State during 1957–58 as a part of the nursery scheme financed partly by the Indian Central Coconut Committee. One of the centres was located at Haradanahally Farm in Chamarajanagar Taluk. 6,763 nuts were supplied to the Farm and were sown in raised nursery beds in good well-drained red soil on 26–1–1957.

During the 2nd week of June, 1957, it was noticed that leaves of a few plants on the borders of the nursery beds showed sings of drooping and by the noon of next day they were found completely withered. A little pull of these affected plants brought the shoot out of the beds and it was noticed that the shoots had been eaten right through just below the ground level, thus separating the shoot from the nut. Termites as casual agents were suspected but on further digging up of the ground near the attacked plants, rat burrows were noticed and the following is a brief account on the control methods adopted.

Review of Previous Literature

There have been reports of coconut plants being attacked by rats. Ayyar (1931) has mentioned that the southern mole rat *Gunomys kok* Gray. damages coconut seedlings in some parts of Malabar by burrowing underneath the soil and feeding on the tender portion of seedlings. Another species, *Rattus rattus wroughtoni* Hinton is said to damage tender coconuts in parts of Madras State and Kerala, according to the same author. Nirula (1954) has suggested a number of remedial measures to control *R. rattus* Bl.

Observations

The field rat *Rattus rattus* Bl. from the surrounding sugarcane fields had perhaps found the palatability of the tender coconut seedlings and had eaten right through the collar region thus severing the shoot from the seed. By about 10 A.M. the leaves began to wilt and droop and if there was severe sun the seedlings were found to dry up by the next day. During the season a total of 409 plants in

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all were attacked and destroyed by the rats. Each rat was found to bite through as many as four to five seedlings in a single night.

Control Measures

Since the rats kept well within the ground leaving no visible trace of their depradation on the surface, baiting them, were of no use. Hence the entire nursery area was flooded to make them come out of their burrows. However, only three rats came out during the period of treatment and were destroyed. The attacks stopped for about two days till the soil became dry and attacks started afresh. Constant flooding could not be undertaken since they would have had a general bad effect on the seedlings.

Further investigations and control measures were taken up in a ryot's field who had obtained in all about 600 plants for planting. Since pits were not yet ready he had put them in a temporary seed-bed near the agave (*Agave mexicana*) fencing of his land.

It was found that all the attacks started on the Agave fence side, as they are the natural harbourers of field rats. The plants had been put in a rectangular trench of about 1½ feet depth, in rows of 8 plants each. The entire plot was covered with sand for about 4 to 6 inches on the top. This nursery was flooded first to drive out the rats and was divided into three parts by removing two rows of plants. All round the northern end a deep trench of 1½ feet width and 2 feet depth was dug up and left open. Baits mixed with zinc phosphide were also kept in here and there every evening and removed in the morning. In the southern end a similar trench was dug up and was filled with sand making a sand enclosure from top to all round the nursery.

The observations on the rat attack noted in the third 8th and 14th day after treatment were as follows:—

	3rd day	8th day	14th day
(*a*) ..	One dead rat and no attack	Nil and no death	2 plants attacked but burrow was found clearly in the trench
Check	**Seven**	**Twelve**	**Fifteen**
(*b*)	**Nil**	**Nil**	**Nil**

The seedlings were planted after the 15th day but filling in of sand was done all round the seedlings while transplanting, and there has been no rat attack reported in this field ever since. This is also confirmed at Haradanahally Farm where 100 seedlings were transplanted adopting sand filling all round the seedlings and not one seedling has been found attacked. In a few ryots' fields in Chamarajanagar where planting was done in red soil without sand enclosure attacks have been reported.

Filling the trenches with sand and covering the entire top of the nursery with a layer of sand of about 6″ thickness is thus found to be very effective in preventing rat attacks as they do not burrow through sand layers. This has been further borne out by absence of attacks in planted coconut seedlings covered all round with sand while those not covered so have been found attacked.

Hence it is suggested that where nurseries are raised in red soil prone to attack by field rats, covering the entire nursery with a thick layer of sand of 6″ and excavating a trench all round it and filling it with sand should be adopted.

General Articles

SOIL MICROBIOLOGY IN RELATION TO PLANT DISEASE[1]

II. Influence of Crop Rotation and Organic Matter on the Soil Microflora

By Dr. H. C. Govindu[2]

Introduction

In the previous paper, physical and chemical factors such as, soil aeration, fertility, moisture, temperature, heat, etc., which play their role in the quantitative and qualitative effects on the soil microflora was discussed. These characteristics are closely correlated with the effect of crop rotation and organic matter. A consideration of these aspects are discussed briefly in this paper.

Use of crop rotation and addition of organic matter to the soil is known to have considerable influence on the soil microflora. In a few cases, crop rotation has still been the recommendation for the control of certain soil-borne diseases. The effects of crop rotation depend on crops grown as well as the agronomic practices, and the natural succession from a primary to climax type of vegetation. The incorporation of organic matter has also been met with certain amount of success in the control of diseases but its use compared to crop rotation is limited. The organic matter has its source primarily with plant tissues, but animal tissues and waste products also to certain extent play an important part in its formation (Lyon and Buckman, 1950).

Crop Rotation

Crop rotation has been one of the ancient and most effective methods of control of certain soil-borne pathogens. From this aspect alone, its effect on microflora of the soil is worth further study. However, additional effects on the microflora are associated with certain species of plants. These plant species, which belong mostly to the

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[1] Second article in the series on the general theme—soil microbiology in relation to Plant disease.

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family Leguminosæ (especially the subfamily, Papilionatæ) are associated with the nitrogen-fixing bacteria that play an important role in the nitrogen-cycle. In recent times, the so-called rhizosphere (region of soil subject to the influence of plant roots) effect of plants has been widely studied. During last two decades extensive studies are made which reveal that this region concerns not only the growth but also the health of plants and the full implication of what is called the ' rhizosphere effect ' embraces interactions involving soil microbes, soil-borne pathogens and the plant. It is in the rhizosphere that the soil microbiologist and plant pathologist find a region of common interest (Lochhead, 1959).

One of the practical aspects of study of crop rotation is in the control of plant diseases. The decrease in disease incidence in several instances has been attributed as due to removal of a susceptible host in most cases. Some of the major plant diseases that are controlled by this method to a reasonable extent are: Texas root-rot (Cotton root-rot) —*Phymatotrichum omnivorum*, bean and pea anthracnose—*Colletotrichum* spp., black leg of cabbage—*Phoma lingum*, wheat bunt—*Tilletia caries*, and onion smut—*Urocystis colchici*, and others. These several examples are only a few of the many that are reported particularly from Western countries, especially United States of America.

Of the several examples listed in the above paragraph, *Phymatotrichum omnivorum* is probably the most studied and best understood root disease fungus in the world today (Garrett, 1959). The economic importance of this fungus is only rivalled by the biological interest of this successful parasite, which forms not only sclerotia functioning in survival of the fungus, but also mycelial strands operating in ectotrophic spread over the host root system. In addition to production of sclerotia and mycelial strands by the fungus and their study as well as a consideration of study of part played by rhizomorphs in root infection has attracted several investigators and these aspects will perhaps concern them for many years to come. Recent studies have indicated that the root-infecting fungi as *P. omnivorum* spread through the soil chiefly on account of exertion of a strong trophic effect of host roots on the fungus resulting of the growth of the fungus over the root systems of its host plants and from plant to plant by root contact. Garrett (1950, 1956) states that the ectotrophic infection habit is a distinguishing characteristic of specialised root-infecting fungi, *i.e.*, of root-inhabiting fungi. For this part of work with *P. omnivorum* alone, the contribution made by Taubenhaus and Ezekiel (1930) is one of exceptional significance. In this connection, a brief consideration of two contrasting types of behaviour amongst root-infecting fungi is necessary to comprehend the importance of study of soil microbiology and root disease fungi: (1) *soil invaders* (exotic or temporary whose presence is limited to certain areas, due to some

local conditions such as, the presence of the host plant and a difference in the soil constituents) and (2) *soil inhabitants* (organisms which play an important and essential part in the economy of the soil). Garrett (1950), however, substitutes the term of root-inhabiting fungi for those specialised root-infecting fungi that can be considered as ' soil invaders '. These two broad concepts that of soil-inhabiting *versus* root-inhabiting fungi have now become interlinked through the third concept of competitive saprophytic ability (Garrett, 1959). This third concept also is stated to interlink facultative *versus* obligate parasites also.

Crop Rotation and Non-Pathogenic Organisms

The influence of the development of higher plants on the soil microorganisms is fairly established. Starkey (1929, 1931) was one of the earlier workers to report that the higher plants exert a pronounced effect. Since that time, there have been several papers published on the influence of the development of higher plants upon the microorganisms in the soil. The influence of plants on the soil microflora are reported to be due to various causes. One of the chief causes being that it is due to some characteristic of root excretions. Not only each plant species but even each plant itself has known to produce a different root excretion. In general, more bacteria were found on or close to the roots with the number diminishing as the distance from the roots is increased. A study of the rhizosphere of several plants (Lochhead, 1940) showed that Gram-negative rods were more numerous than Gram-positive rods, coccoid rod and spore-forming types of bacteria. A comparison of plants susceptible and resistant to bacterial diseases showed that a more active microflora exists in the rhizosphere of susceptible plants. It was suggested that resistance may be linked with the selective action of root excretions on saprophytic soil microflora, thus favouring types which may be antagonistic toward the pathogenic organisms.

Effect of Ecological Progression of Higher Plants on the Soil Microflora

It has been reported, especially among higher plants that they exhibit a definite progression in nature from primary to the climax type of vegetation. Tresner *et al.* (1954) have attempted to correlate relationship between the soil microfungi with the ecological development of the higher plants. It was found that the number of species of microfungi increased from the primary to the climax continuum with the greatest number of species occurring prior to the higher plant climax community. A similar study was made in sand-dune vegetation by Webley *et al.* (1952). It was found that as soon as vegetation began, there was an

increase in the number of fungi and bacteria. But this was not a constant feature, since it depended on the effect of climax plant species. A study of the rhizosphere of three plants progressing from pioneer type to the climax type of vegetation showed that the numbers of bacteria gradually declined with rapid increase of fungi. This shows that there is a close association between the development of soil microflora and the vegetative succession of higher plants. This also shows that the microflora of the soil like in the higher plants has a definite ecological sequence.

Organic Matter

The practice of application of organic matter to the soil has long been considered an important practice in maintaining the soil fertility. The microflora are known to increase in soil rapidly soon after the organic matter is added to the soil for the breakdown of these organic materials to more simple constituents, so that the plants can use them. Waksman and Starkey (1931) state that the nature of the organic matter as well as soil conditions exert their influence on the numbers and type of microflora.

Green Manure Crops

Like the organic matter, so also green manure crops are long been considered to have a considerable effect on the soil microflora. There have been instances where the green manure crop is known to check the incidence of certain plant diseases. Based on this effect, Millard and Taylor (1927) attempted to control potato scab (*Streptomyces scabis*) by the use of certain green manure crops. Work by Rouatt and Atkinson (1950) showed the decomposition of soyabeans, rye and red clover in naturally infested potato scab soil, markedly increased the numbers and types of micro-organisms. Further, soyabean was found to be the only crop, that reduced the incidence of scab. It was noted that in the soyabean soil, a marked increase in the amino-acid requiring bacteria occurred on the tubers, while the amino-acid requiring fungi decreased. The total number of micro-organisms found on tubers, grown in soyabean green manured soil, was considerably less than those in the rye or red clover soil. However, the number of micro-organisms in the rhizosphere of plants grown in soyabean soil apparently associated with the lessening of the severity of the disease.

The use of cover crops, like the green manure crops, are also known to have a similar effect on the check of the incidence of the disease. Blodget (1939) found that the use of cover crops, especially rye caused a reduction in the number of sclerotia of *Rhizoctonia solani* on potato. However, the use of green manure crop and a fertilizer together with a cover crop like rye was shown to cause the greatest reduction in number

of sclerotia. Another instance where a cover crop has been shown to reduce the incidence of the disease is reported by Hildebrand and West (1946). They report that soyabean grown for three years on soil infested with strawberry root-rot reduced the number of organisms markedly and strawberries grown in the soil remained relatively disease-free for a three-year period. These instances go to show, that there is a vast scope in this direction of control of certain soil-borne diseases by growing suitable cover crops and/or green manure crops coupled with proper application of fertilizers. But in planning something like this, it is necessary that there should be close collaboration of several workers of diverse fields, such as, Plant Pathology, Chemistry, Bacteriology, Microbiology and Agronomy.

Animal Manures

The use of barnyard (farm-yard) manure in cultivation of crops has shown that it also effects the soil microflora. The effects of this on the check of incidence of disease is, however, different in certain respects from the effects of those described earlier. For example, the use of barnyard manure was found to increase by 17% over the amount of infection of flag smut (*Urocystis tritici*) of wheat in the check plot (Forster and Vasey, 1929). The addition of lime to the same amount of manure further increased the amount of smut. Some of the factors that contributed to this increase in the incidence of the smut are reported to be due to (1) diseased material being present in the manure, (2) Organic matter provided a medium for saprophytic growth of the pathogen and/or (3) the type of growth of the plant may have made it more susceptible to the disease. It is further indicated that disease organisms could be dissiminated in manure. This fact is substantiated by Gibbs (1931), who found that by feeding cattle with cabbage roots infected with club root (*Plasmodiophora brassicæ*), he could mix the manure from these cattle with sterilized soil and cause infection in cabbage seedlings.

Fellows (1929), on the other hand, reported that addition of chicken or horse manure to the soil reduced the incidence of take-all (*Ophiobolus graminis*) of wheat. Another instance, where substantial decrease of incidence of disease in manured plots was reported by King *et al.* (1934) in case of Texas root-rot. This was indicated as due to the number and activity of competitive organisms, which inhibit the growth and development of the root-rot fungus.

Crop Residues and Soil Microflora

Presence of crop residues in the soil also known to produce an effect on the soil micro-organisms. Waksman and Starkey (1924) reported that additions of not only rye straw and alfalfa meal but also

dextrose, cellulose and dried blood to the soil increased the number of soil microflora. Sweet clover increased the number of fungi more than did the straw and also caused a marked increase in bacteria and actinomycetes.

As decomposition of organic matter progresses, a rapid build-up in the microbial activity occurs over the first six days and then continually decreases until the decomposition is completed (Peele and Beale, 1943). Blair (1943) found that addition of ground wheat straw or dried grass reduced the growth of mycelium of naturally infested soil with *Rhizoctonia solani*. This was attributed to a nitrogen starvation of the mycelium, through the rapid utilization of the available soil nitrogen by the cellulose decomposing micro-organisms.

Garrett (1938, 1940) suggested that survival of *Ophiobolus graminis* in soil depends on the supply of available food and is associated with the amount of competition for this food supply. By adding nitrogen to the soil, the longevity of the fungus was increased. This was ascribed as due to the fact that it enables the fungus to assimilate more of the undehydrated carbohydrate reserves of the straw.

A study of the micro-organisms causing the decomposition was made by McCalla (1953). He found that species of *Penicillium*, *Fusarium*, *Alternaria*, *Trichoderma* and *Chætomium* were the most active organisms in the process when grown in culture. This leads to the conclusion, that certain organisms in the soil survive to a greater extent while others are not. The factors that contribute to this effect are (1) its ability to utilize some of the chemical constituents in the soil more readily than others, (2) the ability of an organism to tolerate soil conditions of reactions, moisture and temperature which may not favour others, and (3) its capacity to produce substances inhibitive (antagonistic) to other organisms. Some of these aspects will be considered in the following papers.

Conclusion

An attempt has been made in this paper to discuss the influence of organic matter and crop sequence on the soil microflora. Though the influence of the two are similar in many respects, their effects were hard to differentiate. Also are discussed the effect of animal manures and crop residues on the soil microflora. A consideration of some of these factors in relation to soil-borne diseases as well as possible control of such diseases are briefly discussed.

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REVIVAL OF PANCHAYATS IN MYSORE

By M. S. Narayanaswamy*

We have entered the Atomic Age—an age where new vistas are revealed, new dreams of achievement are dreamt, and man's life has become more complex and complicated, though, of course, he has got more comforts. The complexities are so great that it has resulted in greater and greater specialisation, that is there is a tendency to more and more decentralisation. Take for example the field of medicine. The knowledge amassed in this field is so great, though we have still to learn much more, that one person—one doctor—cannot handle with justification the whole lot. We must, perforce, have specialists. Though man's body is one unit we have a Specialist for all its component parts. Thus we have the Heart Specialist, the Dentist, the Opthalmist, the Ear, Nose and Throat Specialist, the Orthopodist, Neurologist, etc., and a Specialist even in skin diseases!

It may be seen that this process is apparent in all the fields. In the field of social life this process of specialisation is apparent from very earlier periods. It is common knowledge that one person cannot do all the work quickly and well. The solution to this is, of course, division of labour—which again is a means of specialisation. Thus in early times the society was divided into groups—those who were to defend the society from enemies, those who were to look after the trade of the community, those who were to look after tilling the soil, and those who were to look after the spiritual and the educational needs of the society. A glance at the *Arthasastra* of Koutilya, a socio-political treatise of the great minister of Chandragupta Maurya would reveal that already the specialisation in various walks of life had reached great heights.

But specialisation or division of labour is not the end by any means. It is, of course, essential that there should be unity among diversity. Mere diversity without the element of unity would result in anarchy. Man's condition before he formed himself into social groups must have been akin to anarchy. Each man tending for himself and fighting for satisfaction of basic hungers with each other with the result the strongest survived the struggle.

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This state of affairs did not, naturally, lend itself to peace and well-being of the mankind. Defence against the other wild animals and development of man's genius required that man should organise himself in the interest of survival and progress. The instinct of survival wakens even the wild beasts to form themselves into groups. This must have been the instinct, then, that drove man also to organise himself into tribes. When settling down from the nomadic state, tribes settled down in groups which were the nucleus of the present villages.

Collective living requires lot of give and take. No longer could a stronger man take away whatever he liked from a weaker person. Traditions of communal behaviour developed. The thoughts of intelligent men—men of vision—began to have influence over the behaviour and life, and other men, naturally, began to look for guidance and protection from their stronger and more intelligent brothren.

It can be seen from the available records and tradition that in ancient India social and religious gatherings, with the temple as the pivot, were regular features of the village life. There does not appear to be any distinct political bodies but these general assemblies disposed of both religious, social and political matters. In fact the excavations at Harappa and Mohenjedaro in the Indus Valley indicate the existence of a very developed corporate life in India as early as 5000 B.C.

From tradition we can learn that much importance was given to those assemblies. We have the tradition which says that Dasaratha consulted the assembly of the elders of the city of Ayodhya before finalising the preparations for crowning Rama. Rama whose rule has been the beacon guiding other rulers even to this day, it is stated, consulted this assembly in all important matters of State. As pointed out by Pandit Jawaharlal Nehru in his *Discovery of India* the Village Panchayat or Elected Council had large powers, both executive and judicial and its members were treated with the greatest respect by the king's officers. Land was distributed by this Panchayat, which also collected taxes out of the produce and paid the Government's share on behalf of the village. Over a number of these Village Councils there was a larger Panchayat or Council to supervise and interfere if necessary. This position is revealed by an old book of the 10th century A.D.—the *Nitisara* by Shukracharya.

In South India, particularly, we find in the inscriptions of the 8th century A.D. specific references to village "Sabhas". The Uttaramenur inscription (in Chingalpet District of Madras) of the 10th century A.D. gives a full account of the village communities in the South. According to the inscription the village affairs were managed by six Committees, *viz.*, (1) Annual Committee ; (2) Garden Committee ; (3) Tank

Committee ; (4) Gold Committee, (5) Committee of Justice and (6) Panchavara Committee, of which the general supervision appears to have vested with the first named. It may be of interest to note here that the recent Mysore Village Panchayats and Local Boards Act of 1959, while empowering the Village Panchayat to appoint one or more Committees to perform the functions entrusted to them, provides that there shall be constituted the following Committees:

(i) Agricultural Committee,

(ii) Health Committee and

(iii) Village Industries Committee.

The Uttaramenur inscription also gives details regarding method of casting lots for electing members as well as the stringent qualifications prescribed for the membership. Women were also eligible. Failure to render accounts for public money was a disqualification.

The "Sabha" was practically autonomous though there was certain amount of central supervision. But generally speaking, in internal matters and to a certain extent even in relations between one village and the other, the Sabha appears to have been left largely free from royal control and direction "*containing within themselves all the materials of a State in miniature, these communities were almost sufficient to protect their members if all other Governments were withdrawn. In the continuity of Indian village life and organisation is to be sought the secret of the good things achieved by India in the past in spite of an apparent incapacity to develop political institutions of an advanced character".

It is during the Muslim invasions that the village institutions began to decay because "the paternal solicitude of the Hindu Rulers were replaced by the cold indifference of the new conquerors". The importance of the village institutions began to decay but yet ancient community spirit did not disappear altogether. With the coming of the British Rule, the disintegration of the village community was complete.

But the necessity of associating the villagers with administration was soon recognised. To make better provision for the administration of local affairs of villages by the inhabitants thereof many enactments were made by the various Provinces and States. The Government of Mysore enacted the Mysore Local Boards and Village Panchayats Act during 1918. This was repealed in 1926 and the Mysore Village Panchayats Act of 1926 was passed. This was amendeed in 1930, 1935, 1937, 1938 and 1939.

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* *A Study of Panchayats in Madras*, by Sri. K. Jayaraman.

Under this Act of 1926 (as amended from time to time) the Panchayats were entrusted with certain obligatory functions like construction, maintenance and repair of village roads, drains, cattle pounds, etc., and preservation and improvement of public health. Certain discretionary functions like relief of the poor and the sick, extension of village sites, Development of Education, Agriculture, Co-operation, Rural Industries, etc., were also given. The Panchayats were invested with some powers like power to control erection of buildings, power to maintain and repair of roads vested in them and power to require the removal of unhealthy huts, and rank vegetation on private property to secure good sanitation, etc. As regards finances, the main source of the Panchayat income was the house tax. The assessment of the tax was left to the discretion of the Amildar of the Taluk. Any additional tax was to be levied only with the previous sanction of Government provided that the levy of such tax was agreed to by not less than $\frac{2}{3}$ of the members of the Panchayat. The control of the Panchayats was vested with the Revenue Commissioner, the Deputy Commissioner, the Assistant Commissioner and the Amildar.

Thus the Panchayats, though attempted to be revived, were largely controlled by the Government through its officers. The finances were very slender and powers greatly restricted. As such not much enthusiasm was evinced by the villagers in running the Panchayats. No doubt this lukewarm attitude was in a large measure also due to the growth of party politics in the villages and yet this want of adequate finances, to attend to the obligatory functions, at least, as well as to the existence of complete official control of the working of the Panchayats added to the want of interest. Thus the work of rural development was being attended to by the official agency with the villagers generally in the role of onlookers.

This position was sought to be improved by the rural reconstruction drive which was launched in 1942. No doubt much improvement work was done in many villages especially in the villages selected as model villages. But still the work continued to be planned from above and executed mainly by officials and though the villagers derived certain amenities still they were the works done by Government for the villagers and not work done through the villagers themselves for themselves.

But it is apparent as Dr. John Mathai has said that "it is largely through the development of local Government that people become an organised nation. It is Government of the village, of the municipality that touches most nearly the lives of the people. The importance of the village in Indian administration consists in the fact that the vast majority of its inhabitants still live in villages". It is also through

the administration in villages and municipalities that the largest number can be associated in the governance of the country. If democracy is the Government of the people, by the people, for the people, it is obvious that an ideal democracy will be one where the largest possible number of people are associated in the governance of the country. Thus it is only by the active working of the village institutions that the greatest measure of democracy can be achieved.

This is true also in other forms of Government, which require large-scale participation of people in Government. Thus in Yugoslavia according to Sri. B. Mukerji, the communal system envisages large-scale decentralisation of the authority of Government, which has been transferred in the political, social and economic fields to the communes to secure direct participation of the largest number of citizens in the management of the affairs of the community.*

After the advent of freedom in India, there has been a continuous trend towards this democratic decentralisation. The result was that national extension services were started with emphasis on people's participation, and planning from the village level. The policy has been to associate directly more and more people in the governanace of the country and to interfere as little as possible in the working of the self-governing institutions.

To this end also various States have passed legislation creating District Boards, Taluk Boards and Reorganising the Panchayats. The old stale District Boards and other institutions are abolished. The new institutions as people's organisations, will be responsible for planning and implementation of programmes approved in the State Legislature.

Mysore State also has accordingly passed the Mysore Village Panchayats and Local Boards Act of 1959. By this Act, the old Panchayats and District Boards are abolished and Panchayats on firmer basis created. A Panchayat will now consist of a population varying between 1,500 and 10,000 people and is made a corporate body. Each of them will have between 11 and 19 members elected by ballot, holding the office for a tenure of four years. It will have a Chairman and a Vice-Chairman elected from among the members. The Panchayats are given certain obligatory functions like construction, repair and maintenance of village roads, drains and bridges, public wells, village lighting, maintenance of village sanitation, etc. Certain discretionary functions are also given. They have also the power to acquire and hold property.

Every Panchayat shall constitute three Committees, *viz.*, (i) Agriculture Committee, (ii) Health Commiittee and (iii) Village Industries Committee to look after the Development of Agriculture, Public Health

* Article in *Kurukshetra* of October, 1959.

and Sanitation and Village Industries in its jurisdiction. The Panchayats are entrusted with considerably more powers than before.

Even as regards finances the Act provides for a greater share in the general revenues also. The Panchayat Fund which, previously, generally included house tax only now includes tax on buildings, sites, professions, trades and employments and tax on places where trade is carried on, tax on fairs, on vehicles, fees on bus stands and fee for water-supply. In addition to this, the Government shall also make a grant annually to every Panchayat the amount equal to 30% of the Land Revenue collection of the village. The Government is to assign a further 5% of the Revenue collection of the State to the Panchayats, the amount to be allotted to each Village Panchayat being determined by Government.

At the Taluk level, Taluk Boards are constituted to generally supervise the work of Panchayats and to supplement works of development which are beyond the powers of the Panchayats to execute. These are also popular institutions consisting of elected members and M.P.s and M.L A.s residing in the area. It has also to work through three committees, *viz.*, the Standing Committee, the Audit Committee and Public Health Committee. Taluk Board Fund is also constituted to consist of tax levied by the Taluk Board under the Act and assignment of 20% of Land Revenue of the Taluk by Government.

At the District level, are constituted the District Development Councils. They are to guide, co-ordinate and supervise the work of Taluk Boards. The membership of the Council is made up of the Deputy Commissioner of the District, M.L.A.s and M.P.s of the District, M.L.C.s and Members of the Council of States of the District, Presidents of Taluk Boards of the District, Officers of Government working in the district nominated by Government and a member of the scheduled castes and a woman nominated by Government.

At the outset, I have stated that we have entered the Atomic Age. We can also say that we are on the threshold of democratic decentralisation. The revival of the Panchayats is sure to make democracy the Government of the people, by the people, for the people. As stated by Sri. S. K. Dey* "the Village Panchayats, the Panchayat Samities (we have Taluk Boards instead and the Zilla Parished will mean extension of leadership resources at the disposal of the people. Thus the final picture emerges. The people of India will govern themselves through their representatives in institutions from the Panchayat to the Parliament. There will be Functional Sub-Committees in every institution looking after individual subjects of development". We are on the march towards the real freedom of the common man.

* *Kurukshetra*—October, 1959.

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FOOD RESEARCH: BOON TO INDUSTRY AND THE NATION

By V. Balu[1]

The exciting part of all romances is the quest. Quest is eternal and its thrills universal. Scientists have not lagged far behind. At the Central Food Technological Research Institute or CFTRI, in Mysore, they have been engaged for the past ten years in a pioneering quest for new foods and methods of better utilization of existing foods. They are convinced that there is romance in developing a country by scientific and technological methods ; in investigating into conditions for the processing and preservation of foods ; in evolving different substitutes, supplementary and tonic foods ; and in aiding the food industry to make rapid progress.

The Indian Food Industry is in its infancy and comprises forty different small and large-scale units with an annual turnover of about Rs. 1,500 crores. Till now, the Industry has not had the full benefit of scientific research for its harmonious growth and progress. The CFTRI is trying to bridge this serious gulf ; already it has become the focal point for representatives of big, small, home and cottage-scale food industries who come for knowledge and advice on technical and technological problems.

Tapioca Macaroni

Near-famine conditions and shortage of food prevailed at the time of the inauguration of the CFTRI. Investigations were, therefore, directed towards the conversion of abundantly available second grade articles of food into acceptable, first grade ones. A method was worked out for using blends of tapioca, groundnut and wheat flours in suitable proportions and extruding them as grains. A plant with a capacity of 100 kg. per hour, installed at the Institute, has been preparing continuously not only a grain substitute called Tapioca Macaroni, which is twice as nutritious as rice, but also wheat macaroni. The preparation of Tapioca Macaroni points the way to the elegant utilization of tuber crops like Tapioca which yield 3–4 times as much starch per acre as rice. An extension programme to make Tapioca Macaroni acceptable to the people was initiated in the Kerala State and yielded encouraging results. The Kerala Government took over 100 tons of Tapioca

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Macaroni for large-scale consumer trials and a 20-ton plant is expected to be installed there soon.

Without any processing, a blend of wheat (75 parts), tapioca flour (17 parts) and groundnut flour (8 parts) called *Paushtik atta* has been found to be of great value for the preparation of *Chappathees* and *Purees*. Trials carried out in U.P. have shown that the blended *atta* is acceptable to wheat-eaters. An annual production of 9 lakh tons of blended *atta* will result in a saving of 2·3 lakh tons of wheat which is now imported. A blend of tapioca (75 parts) and groundnut flour (25 parts) called "Mysore Flour" has also been successfully tried and fed to several thousands of people in famine-stricken areas in Madras and Mysore States.

Tapioca Macaroni and blended flours will conserve rice and wheat stocks and result in the proper utilization of starch at the same time providing balanced and protein enriched food.

Vegetable Milk

To meet the shortage of milk and milk products in the country, a nutritious vegetable milk has been produced at the low cost of about two annas a pound. Fortified with vitamins and minerals, the product has approximately the same composition as the animal milk. Vegetable curds from the milk have been prepared on a pilot-plant scale for several years and sold to catering establishments in Mysore. A dehydrated vegetable curd, which on reconstitution yields the original product, has also been prepared.

Multipurpose Food

A very useful product is the highly nutritious, low-cost Multi-purpose Food, or MPF, prepared from specially processed groundnut meal and bengal-gram flour. Two ounces of MPF costing about eight naye paise provide a large part of the daily requirements of proteins, vitamins and minerals for adults. The product is made in spiced and unspiced forms and can be incorporated in common food preparations without affecting their taste, but enhancing their nutritive value. Work on this food has derived generous support from the American Meals for Millions Foundation as well as the Meals for Millions Association of India formed in 1955 with Dr. Punjabrao Deshmukh, Union Minister for Agriculture, as the President and Mrs. Mary Clubwala Jadhav and Lady Rama Rao as the Vice-Presidents.

'Nutro' biscuits incorporating a modified composition of the MPF have been made and have thrice as much protein as ordinary biscuits now marketed. The Prime Minister generously donated a

lakh of rupees from his relief fund and one lakh pounds of such biscuits were produced and distributed in flood and distress-affected areas of the country. The pilot plant at CFTRI which has a capacity of two tons of MPF per day has distributed over 5 lakh pounds of MPF to different institutions in the country. An extension project initiated in the Coimbatore District of the Madras State has resulted in the regular use of the MPF by 4,000 children in 87 schools. Mysore schools have also started the use of this food in the midday meal programme.

Sustained efforts have been made to interest the various States in India in the manufacture of MPF. The Governments of West Bengal and Madras have decided to put up Units for producing the food. In these efforts, the lead has been given by Dr. P. S. Deshmukh, Union Minister for Agriculture and Professor M. S. Thacker, Director-General, Council of Scientific and Industrial Research.

Integrated Process

India produces several million tons of groundnut and other oilseeds rich in proteins. In commerce, the oil is removed from these by expellers and the residual meal or cake, containing about 50% protein, used as manure or cattle feed. An important project at the CFTRI pertains to a wet rendering of the oilseeds, whereby drastic treatment of the materials is obviated and the different constituents, like the oil, the protein and the starch, are obtained in their native form, in an integrated manner. The oil thus obtained has a better keeping quality and can be used straightaway for hydrogenation without refining or bleaching. The proteins can be incorporated with foods and also used for industrial purposes. The third fraction, the starch-*cum*-fibre could also be used as food.

Since 1950 sixty students have undergone the post-graduate diploma course in fruit technology conducted by the CFTRI. Analytical work in connection with the administration of the Fruit Products Order of the Government of India was started in 1953 and is being pursued. 35,000 samples have been analysed and on the basis of the data obtained, measures have been suggested for further impovement in the quality of Indian preserved fruits and vegetables.

Improved Method of Parboiling Rice

An improved method of parboiling rice has been worked out as a result of which the processing time has been cut down from the normal three days to about three hours. Also there is reduced breakage and better recovery of the whole rice. This is of considerable significance since the commercial samples of parboiled rice often exhibit undesirable off-flavours and are also unattractive in appearance. These defects

have been overcome by the new process which has been worked successfully in several rice mills. If all the rice in India were to be used in parboiled form, this would increase the availability of rice by about half a million ton. Moreover, parboiled milled rice is more nutritious than raw milled rice.

As an effective measure of improving the nutrition of rice, a method has been worked out for the successful introduction of calcium into milled rice. This is done by spraying rice with a solution of calcium acetate, steaming and allowing to cool in a humid atmosphere, which results in a product containing about 100 mgm. of calcium. Also in collaboration with the Central Salt Research Institute, Bhavnagar, Sea-salt has been produced containing 1% calcium for edible purposes.

Insect pests cause an annual loss of 2–3 million tons of food grains in our country. A new prophylactic process has been developed combining all the merits of fumigation of grains and impregnation of gunny bags for treating grain bags *in situ* in godowns. Processed foods and dry fruits require quick disinfestation treatment at low cost to maintain a satisfactory marketable quality both at home and abroad. Methyl bromide is widely used for the purpose, but this has to be imported at high cost. Based on the principle of vacuum desorption from treated food-stuffs, a new process has been evolved for the re-use of the residual fumigant.

Research on Coffee and Tea

Tentative standards for coffee have been worked out by a Coffee Research Unit functioning at the Institute under the auspices of the Coffee Board. A " wetting " technique to obtain more cups of coffee from a given amount of coffee powder has been developed. Filters designed for household use to give better extraction and percolation are now available to the public from the Coffee Board. A similar Unit on behalf of the Indian Tea Board has been set up to study the problems of the Tea Industry and carry out research on the chemistry and technology of tea.

A survey of protein-rich foods indicated that some of them like *Dolichos lablab*, Blackgram, casein (milk protein) had a definite hypoglycemic effect (lowering of the sugar level in the blood). Further studies are in progress to establish the mode of action of such products and their application in the treatment of diabetes.

Other Efforts

Optimum conditions have been determined for the cold storage of large number of fruits, vegetables and other perishable commodities. A fungicidal wax developed by the Institute for coating fruits has helped

to extend their storage life, even at ordinary temperatures. Hormone treatment has been found effective in prolonging the period of retaining of perishables. An integrated process for the economic utilization of tamarind pulp to obtain pectin, tartaric acid and sugary syrup has been worked out. A simple vinegar generator suitable for use in homes has been devised. Technical aid has been provided to the Indian Sago Industry ; methods for the preparation of Sago and standards in the product have been suggested.

Out of nearly 30 processes developed at the CFTRI, sixteen including 6 non-patented ones, have been released to the Industry. These cover preparation of infant food from buffalo milk, malted milk foods, fruit juice powders, composite protein food, fermented soyabean product like marmite, mango cereal flakes, manufacture of ginger cocktail and of Baker's Yeast now imported.

Considerable work has been started on the technology and processing of fish and meat. The armed forces are now importing canned drinking water from U.K. Conditions have now been standardised for canning drinking water. Attempts have been successfully made to prepare a base for chewing-gum from indigenous raw materials.

Food Engineering

The Division of Food Engineering has designed and fabricated several items of equipments required for process development programmes of the Institute. It has also assisted other institutions and industries by furnishing designs for plant and equipment required for them. The Division has fabricated All-Stainless Steel Multipurpose Evaporator and Rotary Vacuum Drier as well as spin retort for cans.

Rice bran available in plenty during rice milling is now fed to cattle. By a simple method, using alcohol as solvent, the oil from the rice bran has been extracted, giving by-products which include bran meal, sugar and rice wax. Bran meal as cattle feed keeps better than the original bran.

Considerable work has been done on the packaging of foods. Insulation and cushion boards have been developed from agriculture wastes like cocoanut pith. Garlic powder of high quality has been prepared and the technological aspects of dehydration worked out. A weaning food in powder form has been standardised from soyabean and groundnut. The detailed analysis of black pepper to help in export promotion and the better utilization of pepper rejections has been undertaken. A hard type of vegetable cheese has been made from the groundnut and will be a boon particularly to vegetarians.

Of interest to the hotelier and the housewife is a composite *Idli* mix which contains blackgram flour, rice semolina and the fermenting agents in a ready-to-use form. Some firms in South India have already taken up its production and distribution.

A new Unit started under the auspices of the I.C.A.R. has been engaged on researches with reference to the Arecanut.

The Institute has efficient methods of disseminating the results of research to the common man. It publishes an English monthly *Food Science* which has received recognition in India and abroad. Popular publications in Kannada and Hindi are also issued. For men in industry special project circulars and reports of symposia have been published. Of interest to the housewife are 66 semi-technical leaflets dealing with the home-scale preparations of fruits and vegetables, Indian sweets and substitute foods. An extension unit has been working to disseminate information pertaining to various processes and the use of products developed at the Institute particularly in rural areas.

Thus, the CFTRI has done a large volume of useful work ; but, as Dr. V. Subrahmanyan, the Director, has often pointed out: " India has just made a beginning in food research and food technology. Vast strides have been made in these subjects in Europe, and countries like the U.S.A. In the U.K., there are six stations dealing with food problems under the Food Investigation Research Board. The leading food and allied industries in Britain have also got their own research laboratories. A great deal of work in food technology is also in progress in Canada, Australia and New Zealand. In the U.S.A., several laboratories function under different auspices, many of them with annual research budgets of over a million dollars. The Soviet Government has invested millions of roubles into building enterprises of the U.S.S.R. food industry. However, it is to be hoped that our industrialists will make increasing use of our findings so that in the matter of food technology India does not lag behind the rest of the world."

SALINE-RESISTANT LEGUMINOUS GREEN MANURE PLANTS

By M. J. Dawson*

Application of large quantities of green matter such as the leaves and twigs of various plants, trees, shrubs or crop as a whole, either cut and brought from outside or grown *in situ* and ploughed in as green manure is a cheap and easy method of improving the soil fertility in irrigated lands. Leguminous crops are preferred to non-leguminous crops for growing *in situ* as the former contain large amounts of Nitrogen fixed from atmosphere with the help of soil bacteria. In the saline and alkali tracts of northern districts of the New Mysore State, even grasses are scorched to death during the dry season due to concentrated form of salts formed on the surface soil. Therefore, Leguminous or other green manure crop to grow in these areas should naturally be saline-resistant.

According to Sarin and Rao (1958), "That legumes are more susceptible to saline injury than cereals has been recognized by several workers, although, causes are not still clear". However, contrary to this generalization with regard to legumes as a whole, certain leguminous plants have been found to be salt-tolerant. Daincha (*Sesbania aculeata*, Poir) is a leguminous green manure plant suitable for heavy clays and soils that are saline and alkaline, withstands water-logging and drought, and can yield 10,000 to 15,000 lb. of green matter per acre (Govindarajan, 1955). Normally it yields about 4,000 to 6,000 lb. per acre. The nutrient value of this plant is comparable with that of any other plants used as green manure (*cf.* Table I).* In Bombay State, it has been found to keep the salts in the soils at a fairly low level (Panikkar, 1957).

In Hiriyur Taluk of Chitaldrug District in Mysore State, where, as a result of high degree of alkalinity and salt accumulation, crop failures have rendered farmers panicky and give up cultivation in many places. Inspection survey of six villages during 1959–60 has revealed that not even grass or weed thrives during the dry periods. The pH, electrical conductivity and salt contents of irrigation waters

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and soils of four villages are shown in Table III. During the dry periods, the salt concentrations increase to over 6,000 p.p.m. as a result of rapid

TABLE I

Major Nutrient Contents of Some Important Leguminous Green Manure Crops **

Common Name	Latin Name	Percentage		
		N_2	P_2O_5	K_2O
*1. Daincha ..	*Sesbania aculeata*, Poir.	0·68	0·13	0·40
2. Sunnhemp ..	*Crotalaria juncea*, L.	0·89	0·12	0·51
3. Cowpea ..	*Vigna catiang*, Walp.	0·71	0·15	0·58
4. Horse gram ..	*Dolichos biflorus*, L.	0·91	0·18	0·65
5. Sesbania ..	*Sesbania speciosa*	0·70	0·14	0·78
6. Glyricidia ..	*Glyricidia macculata*	0·68	0·16	0·80
7. Kolinji ..	*Tephrosia purpurea*, Pers.	0·75	0·20	0·60
8. Green gram ..	*Phasiolus radiatus*, L.	0·72	0·18	0·53
9. Black gram ..	*Phasiolus mungo*, L	0·85	0·18	0·53
10. Avare ..	*Dolichos lablab*, L.	0·75	0·14	0·56

** Govindarajan, 1955 and Yegna Narayan Aiyar, 1953.

evaporation of soil water, which in its course brings salts to the soil surface where crystalline form of white encrustations are formed and seen scorching grass and other weedy vegetation. During this time paddy crop reaches the stage of maturity but grain formation is seriously affected resulting in reduced or no yield.

While the soil conditions are so adverse to plant growth, it was observed, the weed called tanner's cassia (*Cassia auriculata*, L.) locally known as Thungadi belonging to the natural order Leguminosæ, grows well. It is a small shrub with pretty yellow flowers and appreciable green manure value. The Nitrogen and potash contents of its leaves are very high (*cf.* Table II). The leaves of this plant thus being available in this tract will be greatly useful in the reclamation of the soil.

TABLE II

Major Nutrient Contents of the Leaves of Some Green Manure Plants

	Common name	Latin name	Natural order	Per centages		
				N_2	P_2O_5	K_2O
1	Hongey (Indian Beech)	*Pongamia glabra*, Vent.	Leguminosæ	1·16	0·14	0·49
2	Thungadi (Tanner's cassia)	*Cassia auriculata*, L.	,,	0·98	0·12	0·67
3	Yekka ..	*Calotropis gigantia* R.Br.	Asclapiadaceæ	0·42	0·12	0·37
4	Lantana ..	*Lantana aculeata*, L.	Verbinaceæ	0·88	0·15	0·90
5	Ugani hambu ..	*Lettsomia* species.	Convolvulaceæ	0·63	0·14	0·47

* Govindarajan, 1955.

TABLE III

pH, Electrical Conductivity and Total Soluble Salts of Irrigation Tank-Waters and Soil Extracts of Four Villages in Hiriyur Taluk

	Name of village	Irrigation tank-waters			Soil extract		
		pH	E.C.	T.S.S. (in p.p.m.)	pH	E.C.	T.S.S. (in p.p.m.)
1	Dharmapura ..	9·0	2·00	1400	10·0	11·5	8050
2	Javanakondanahalli ..	9·3	1·95	1365	8·5	5·5	3850
3	Animangala ..	9·3	1·65	1155	9·0	3·6	2620
4	Ambalagere ..	8·7	0·65	455	9·0	9·0	6300

(E.C.: Electrical Conductivity in millimhcs/cm. at 25° C. and T.S.S.: Total Soluble Salts determined as described in *Agricultural Handbook* 60, "Salire and Alkali Soils", U.S.D.A. (1954).

Hengey trees (*Pongamia glabra*, Vent.) also, a member of the Leguminosæ order, yielding green manure leaves of great value are grown in these areas. The leaves of this tree are very rich in Nitrogen containing over 1·0% (*cf.* Table II), and are generally used as green manure.

Only salt-tolerant plants can thrive in soils whose water extract (1 : 2) has electrical conductivity ranging from 4 to 8 millmhos per centi-

meter (Greene, 1953). Thus the two leguminous green manure plants, Thungadi and Hongey growing in these areas where the electrical conductivity of soil extract is even more than 8 millimhos/cm. and pH of both soil and irrigation water is very high (8·5 to 10·0 or even more), are highly tolerant to salinity and alkalinity. These plants can be profitably exploited in the improvement of saline and alkali lands on this tract, by using their leaves collected from wild growths on waste lands or from plantations.

References

1. Greene, H. (1953), "Using Salty Lands", *FAO Agricultural Studies*, No. 3, 43.
2. Yegna Narayan Aiyer (1953), *Principles of Crop Husbandry in India.*
3. Richards, L. S. (1954), *Agricultural Hand-book No.* 60, *Saline and Alkali Soils*, U.S.D.A.
4. Govindarajan, S. V. (1955), *Manures and Fertilizers*, *Bull. No. I, Chemistry Series*, Mysore State Department of Agriculture.
5. Panikkar, M. R. (1957), "Co-ordination of Agricultural Research in India," *Chemistry and Soil Science*, **3**, I.C.A.R.
6. Sarin, M. N. and Rao, I. M. (1958), "Physiological studies on Salt-Tolerance in crop-plants. III. Influence of Sodium Sulphate on Seedling Respiration in Wheat and Gram," *Ind. Jour. Plant Phyl.*, 1, 30.

Abstracts

AGRICULTURAL CHEMISTRY

1. Desai, A. D. (1959). " Conditions of rice-growing soils and means of improving fertility by application of manures and fertilizers," *Proc. Ind. Acad. Sci.*, **49**.

Experiments conducted during 1950–56 on the nutrition of wet paddy grown on red and black soils, deficient in Nitrogen and Phosphoric acid, of former Hyderabad State showed:

1. Paddy did not grow without application of Phosphoric acid.

2. Per acre of the soils, the manurial requirement of Nitrogen and Phosphoric acid was much more than the actual uptake by paddy crop.

3. Red sandy loam required 60 lb. Nitrogen per acre as optimum dose with $N : P_2O_5$ ratio as 1 : 1/2. Black cotton soils required 45 lb. Nitrogen per acre as optimum with $N : P_2O_5$ ratio as 1 : 3/4.

4. Long duration paddy crop takes in over 60% of dry matter, Nitrogen and Potassium during the reproductive phase, while the absorption of P_2O_5 is gradual, taking in only 28% during reproductive phase. The maximum uptake of Phsosphoric acid was during tillering.

5. Maximum returns of short duration paddy crop can be obtained by the application of N and P in one single dose at puddle in the case of black clayey soil and by split doses of Nitrogen, *i.e.*, half at puddle and half at weeding in the case of light soil.

6. 20% more of paddy yield could be obtained on black clayey soil by pretreating the seedling-roots with manure and mud-slush before transplanting.

7. Nitrogen and Phosphoric acid, applied as ammonium sulphate and superphosphate, are not appreciably lost to paddy crop by vertical sub soildrainage.

8. Paddy crop tolerates salt concentrations (NaCl) in irrigation water up to 0·2% ; yields considerably low between 0·2% and 0·5% and dies above 0·5%.

9. Subsoil drainage is essential for paddy though grown under standing water. Ill-drained conditions lead to sulphide injury to roots when sulphatic fertilizers are applied.

10. Paddy crop suffers if green manured under ill-drained conditions.

2. Agarwal, R. R. and Yadav, J. S. P. (1956). "Salinity and Alkali Scale to Evaluate Soils for Crop Responses," *Jour. Ind. Soc. Soil Sci.*, **4** (3), 141.

In the evaluation of saline areas, salinity scale is in general and wide use as in U.S. Salinity Laboratory for appraising the effect of soluble salts in the soil on crop growth. Such a scale cannot be used in alkaline areas of Indo-Gangetic Alluvium, as both salinity and alkalinity affect crop growth in this region. By a systematic investigation conducted during two seasons (1954–55) in the District of Kanpur, a Salinity-*cum*-Alkali Scale has been proposed to evaluate crop response rating of Indian saline and alkali soils.

(M. J. Dawson)

PLANT PHYSIOLOGY

1. Anon (1958). "Sample survey on pepper crop in Kerala," *Statist. Newsletter* **8** (1), 5.

Summary of results of a pilot sample survey of cultivation practices, estimaiion of area and yield of pepper during 1956–57 in the State of Kerala excluding the districts of Malabar and South Canara are given. Average yield of black pepper per bearing standard was 21·5 oz. Marakku (*Erythrina indica*) was the most popular type of support for pepper. Kaniakadan is the most popular variety grown. Ammonium sulphate, bone-meal, cowdung, green leaves, ash, oilcakes, compost, etc., were the different kinds of manures used and the manured plots gave an extra yield of 8·6 oz. per standard over unmanured plots. Soil conservation measures were popular. Pests and diseases reduced the yield.

2. Anon (1958). "Study of dependence of fertiliser response on soil nutrients," *Statist. Newsletter*, **8** (4), 13–14.

In order to find out whether there is any association between the responses to fertilisers in manurial experiments in cultivators' fields scattered all over India and the different soil nutrients as revealed by chemical analysis, data were collected and statistically examined. An investigation of the data collected from Bihar, Bombay, Madras and West Bengal does not indicate any significant relationship between fertiliser response and soil nutrients.

3. Vasudeva, R. S. and Capoor, S. P. (1958). "Citrus decline in Bombay State," *F.A.O. Plant Prot. Bull.*, **6** (6), 91.

During a survey of virus diseases of plants in the Bombay State in 1955–56 citrus plantations were examined and some diseased trees of Mosambi sweet orange (*Citrus sinensis* var. *mosambi*) were found to show symptoms similar to those caused by virus diseases.

4. Desveaux, R. (1958). "The various modes of expressing the results of chemical analysis of fertilisers and plants," *Fertilite*, **4**, 19–24.

The quantities of nutrients contained in a fertiliser or crop is usually expressed as oxides, elements or milliequivalents. The author discourages the use of different modes and pleads for the universal adoption of the simple, clear and non-prejudicial notation in elements.

5. Jayaraman, V. (1957). "Effect of continuous use of ammonium sulphate on the calcium status and reaction of soil," *Fertilite*, **1**, 15–16.

Soil samples from a 27-plot manurial experiment have been analysed and the data showd that 200 and 400 lb. of ammoniun sulphate for 12 years has resulted in a significant reduation of pH value and the higher application has also reduced the calcium content significantly.

Phosphoric acid and potash applications have not shown any difference.

6. Venkatramani, K. S. (1957). " Foliar application of fertilisers to tea," *Fertilite*, **1**, 17–21.

In an experiment on tea where 52 lb. K_2O per acre and N P K mixture (50 lb. N, 15 lb. P_2O_5, 52 lb. K_2O per acre) were applied to the foliage in the form of spray significant responses were obtained showing that tea bushes could absorb nutrients through the foliage. No comparison is made between foliar application and soil application.

7. Karwar, J. S. and Grewal, J. S. (1959). " Behaviour of different phosphatic fertilisers in Punjab soils," *J. Indian Soc. Soil Sci.*, **6** (4), 215–22.

Eleven different kinds of phosphate fertilisers were incubted with acid and alkaline soil samples from Punjab and it was found that in acid soils the water-insoluble forms of rock phosphate, bone-meal or tricalcium phosphate changed to soluble forms. Also it was found that phosphoric acid and aluminium phosphate are quite suitable for calcareous soils.

8. Dunham, C. W. (1958). " Use of methylene blue to evaluate rooting of cuttings," *Proc. Amer. Soc. Hort. Sci.*, **72**, 450–53

A colorimetic method using a solution of methylene blue dye displaced from plant roots is described and the advantages discussed.

9. Lingle, J. C., Holmberg, D. M. and Zohel, M. P. (1958). " The correction of zinc deficiency of tomatoes in California," *Proc. Amer. Soc. Hort. Sci.*, **72**, 397–402.

Zinc deficiency causes an increase in K, Ca and Mg concentration in the tissues of tomato plants in California. In field tests for correcting Zn deficiency neither foliar sprays nor side dressings of different zinc carriers provided satisfactory correction.

10. Anon (1959). " Fertiliser experiments on sugarcane at Belal Farm of the Nizam Sugar Factory Limited, Nizamabad District (India), 1955 to 1957", *Potash Review*, 27/28 March, 1959.

In the randomised block experiment with 3 levels of P and K with chalka and Regur soils in 1955–56 and 1956–57 100 lb. K_2O per acre has given significant increase in yield and higher C.C.S. per cent. to cane.

In the 3^3 confounded design with 3 levels of N, P and K no significant response was got to any treatment.

11. Ogihara, T. (1958). " Studies on potash deficiency in paddy rice," *Potash Review*, 5/9 February, 1958.

The contents of total nitrogen, solbule nitrogen and protein nitrogen are all higher in potash-deficient paddy rice than in normal plants. The number of amino-acids and amides was greater in potash-deficient rice compared to normal plants.

12. Nicol, H. (1959). " Encourage the metal base for high production," *Fertiliser News*, **4** (4).

The need for attention on the metallic base for the sake of its action, both on soil acidity or pH and on ionic balance or G, is stressed.

13. Asana, R. D. (1957). " The problem of assessment of drought-resistance in crop-plants," International Symposium on Genetics and Plant Breeding in South Asia. *Indian Jour. Gen. and Pl. Br.*, **17** (2), 370.

Literature relating to the finding that desiccation and other tests and xerophilous characteristics as inconsistent indexes for drought-resistant crop plants have been surveyed. Examples showing the complexities of the far-reaching effect of water shortage on plant metabolism and morphogenesis have been given.

The work on drought-resistance in wheat at the Indian Agricultural Research Institute has been summarized. Yield and 1,000 grain weight were negatively correlated with temperature during ripening period. There was little differential varietal response to soil drought. Under normal conditions of water-supply, ear-number had the most potent effect on the yield of early and medium-early varieties, while under conditions of drought, grain-number per ear and 1,000 grain weight were as important as ear-number. Therefore, grain-number per ear and 1,000 grain weight should also be considered in selecting varieties for dry areas.

14. Kamra, S. K. (1959). "The Effect of Treatment with Absolute Alcohol on Seeds of Different Species", *Ind. Jour. Plant Physiol.*, $\mathbf{2}_1$ 132.

Experiments conducted to study the resistance capacity of the seeds of *Lens esculenta*, *Secale cereale*, *Brassica rapa*, *Allium cepa*, *Lactuca sativa* and *Pisum sativum* to the action of absolute alcohol showed:—

(i) loss of germination in all cases with damage occurring at different stages for different species. *Secale cereale* and *Lens esculenta* being most sensitive showed considerable decrease in germination within 24 hours. *Pisum sativum* showed the most resistance while *Brassica rapa*, *Allium cepa* and *Lectuca sativa* showed moderate resistance.

(ii) the differential resistance to alcohol of the seeds of various species could be discussed in the light of two view-points: (*a*) prevention of entry of alcohol by cell membranes and (*b*) resistance of the protoplasm.

(iii) seeds that remain viable under normal conditions for a longer period (in some cases up to 5 years) showed greater resistance than those with shorter life period.

M. J. DAWSON.

Review

SOIL POTASSIUM by R. F. Reitmeier. POTASSIUM IN PLANT NUTRITION by Kirk Lawton and R. L. Cook.

A brochure of two valuable and exhaustive articles, dealing with Plant Physiology and Soil Chemistry in relation to Potassium, reproduced from *Advances in Agronomy*, Vol. 3 (1951) and Vol. 6 (1954).

This is a unique edition of literature, easily understandable with fluent language covering all aspects of the role of Potassium, collected from the latest experiments and analyses carried out by the eminent scientists all over the world. It is a valuable Handbook for Agriculturists, Plant and Soil Scientists and for Research Laboratories.

Forms of Soil Potassium and their availability to plants, relationship of soil micro-organisms to Soil Potassium, effect of aeration and compactness on availability of Potassium, movement and distribution of Potassium in the Soil Profile, are the interesting chapters in the first article, ' Soil Potassium '.

In the second article entitled " Potassium in Plant Nutrition," there are more chapters dealing with the role of Potassium in the formation of carbohydrates and their transportation, the asismilation of CO_2, the formation of organic acids and vegetable oils, the synthesis of protein nitrate absorption, cell division, photosynthesis, turgor mechanism; deficiency symtoms; potash requirements of various crops; and analysis of plant potassium, etc.

The authors deserve congratulation for their successful attempt in bringing out such voluminous information in concise and easily understandable form.

M. J. DAWSON.

Forum News & Notes

The members of the Mysore Legislature responded to an invitation to Tea by the Farmers' Forum and contributed to a pleasant evening at the premises of the Forum on the 15th April 1960 enquiring after the activities and projects of the Forum and the Mysore State Young Farmers' Association.

* * *

Sri. D. V. Murthy, Senior Assistant Entomologist and Associate Editor of the *Mysore Agricultural Journal*, left on deputation to United Kingdom on 16th April 1960 under Colombo Plan for a period of six months to undergo advanced training in Plant Protection methods. During his tour abroad, he will visit France, Germany, Switzerland to study the progress made in Plant Protection in those countries.

* * *

The General Body Meeting of the Forum was held on the 22nd and 23rd of April 1960 and *inter alia* the body passed the folowing resolutions:

1. Thanking the Government of Mysore for a matching grant of Rs. 36,018 for the year 1959–60.
2. Requesting the representation of the Forum on the several State-level and local developmental committees.
3. Suggesting in the interest of Mysore Farmers in general to strengthen and increase the scope of the Agricultural Department Information Service.
4. Requesting that dusters and sprayers may be continued to be supplied at 50% concession.
5. Asking for an intensification of plant protection measures, and
6. Suggesting taking into consideration the points elucidated in the Commodity Committees.

Four group meetings were held on Crops and Commodities along with the General Body Meeting: (1) On Fruits and Vegetables; (2) On Dairying and Animal Husbandry; (3) On Oil-seeds and Cotton and (4) On Cereals and Pulses.

The group on Fruits and Vegetables passed the following resolutions:

1. *Resolved* to move that proper marketing facilities, assuring a fair price to the growers of the vegetables, fruits and flowers be secured through the Service Co-operatives or through

Farmers' Forum Co-operatives at Hobli, Taluk and District levels.

2. *Resolved* to move with the A.I.R. for broadcast on Horticultural crops.

3. *Resolved* to move with the Farmers' Forum and concerned authorities to look into the possibilities of more extended supplies of insecticides and fungicides.

4. *Resolved* to move with the concerned authorities for supply of disease-free seeds of potatoes and other horticultural crops.

5. *Resolved* to move with the concerned Departments for an investigation on problems like the failure of Banana after Brinjals and simlar problems.

6. *Resolved* to move that a Horticultural Survey of the State be conducted with reference to horticultural crops, cultivation practices and marketing facilities.

7. *Resolved* to move that bee-keeping be popularised and encouraged on a large scale.

8. *Resolved* to move that loans may be granted on the standing crops, to encourage fruit production.

The following points came up for discussion in the Dairying and Animal Husbandry Committee:

1. Organisation for the supply and distribution of milk came up for a good deal of discussion. It was opined that milk produced in villages may be collected in some centres and arrangements made for its disposal through co-operatives. Service Co-operatives may undertake this work or separate Milk Unions may be organised, Village Panchayats taking the lead and technical aid being given by the Development Department. Supply of concentrates may also be undertaken by the above co-operatives.

2. Disposal of half-bread males was considered. It was suggested that these are not absolutely useless and they could be used for such light draught purposes as Persian Wheels, manure carts, water carts, etc. Old animals may be entrusted to the care of Pinjrapoles, etc. It was felt that the Departments concerned should consider the case of these.

3. *Stepping up Milk Production.*—It was recognised that in Mysore both the cow and the buffalo are essential. Upgrading of local stock was felt necessary. It was opined that for distribution of improved animals loans should be given at reasonable rates of

interest and a certain amount of subsidy by Government may be called for.

4. *Cattle Feed.*—The group was of opinion that edible oilcake should be reserved entirely for cattle feed. Export of any is to be made after giving top priority to cattle feed purposes. Regarding bulk fodder utilsation of paddy straw was of special importance, ragi straw was costlier. Collection of paddy straw from channel areas must be arranged during harvest time and pressing it into small lots for facilitating easy transport considered. It is also suggested that the Department of Agriculture or Animal Husbandry should experiment with the pretreatment of paddy straw to suit the feeding of milk cattle and popularise the means. A kind of registration of milk producers in different localities is suggested and the requirements of concentrated fodders is to be made available to the registered milk producers at reasonable rates through Service Co-operatives or some other suitable organisation. The Government waste lands should be reserved for purposes of grazing lands so as to provide necessary fodder to milk cattle. The local Panchayat or the Service Co-operative is to be entrusted with the management or such grazing lands.

5. *Livestock Insurance.*—The group is of opinion that Livestock Insurance may be adopted in selected dairying blocks, on the verification of registered milk producers after ascertaining the proper maintenance and care of animals.

6. It was suggested that facilities such as subsidies, loans, etc. are to be made available only to Registered Milk Producers who stock to certain standards fixed by the Department of Animal Husbandry.

7. The group considered the improvement of sheep, poultry and fishery piggery and the apiary; and it was opined in all cases that breeding stock should be supplied to interested agriculturists on concession as also appliances and accessories.

In the Oil-seeds and Cotton Group:

Seeing that seed supply was an important point for consideration the group *resolved* that the Government be requested to have two centres under their own control per district, to have adequate seed supply till such time as either good co-operative societies or a good organisation of registered seed-growers are well established, and in places where either co-operative societies or registered seed growers are, generally, all Government help should be chanelled through them.

It was felt that an adequate number of representatives of this Forum must be in the State Evaluation Committee for Oil-seeds to

enable implementation of several schemes that are calculated to benefit the farmer.

In connection with Plant Protection measures, the group was of opinion that the staff has to be increased and squads of actual workers appointed.

Biological control of insect and pests has to be amplified and at each district headquarters there should be a mechanised unit and a power mobile with adequate insecticides and pesticides.

It was also felt that to begin with a free distribution of insecticides and pesticides may be necessary to make farmers plant-protection-minded.

Loans were considered necessary for purchase of seeds, manures, etc.

The group felt that the storage system should considerably be improved.

It was felt that the staff on oil-seed work in the State was inadequate and reinforcement was necessary both on the research and on the propaganda side.

In promoting castor cultivation in waste and other lands, it was felt that the same facilities such as afforded to cashewnut cultivation may be given to this crop also. In the same way problems connected with different oil-seeds have to be examined.

Safflower cultivation is declining. Breeding of good seed for this has to be taken up urgently. It is recommended that work on seasmum should be urgently taken up.

The group recorded a recommendation that oil pressing on small model expeller system for decentralisation of oil pressing industry be carefully examined and all efforts made to establish such units.

Regarding the cotton crop, the group gave some considerations to a suggestion for free supply of improved seed and examining possibilities of the Central Cotton Committee subsidising such a scheme.

Combating of pests and diseases of the cotton crop and a 50% subsidy in this regard were felt to be important points to be considered.

With reference to marketing the purchase of cotton by petty merchants in the villages was still considered a great difficulty in the way of working any scheme of pure seeds and the group felt that the licencing of small merchants in this regard should be stopped.

The group felt that officers, cultivators and office-bearers of co-operative bodies intimately connected with the crop may be sent abroad

for a study with reference to the problems experienced by them so that ideas carried back by them may be helpful to the industry.

The Cereals and Pulses Group was of opinion that the State is at present self-sufficient with regard to millets and pulses while it is not so with regard to rice.

It was felt that the present level of production can be further increased easily and the State can be made self-sufficient if not surplus if the following steps are taken by the Government:

(*a*) Taking up major irrigation works, like construction of dams and *anecuts* and providing water through the channels. Construction of pick-ups to the *hallas* and streams, under the minor irrigation programme. Draining valleys causing marshiness and leading to alkalinity in irrigated areas, desilting and restoration of tanks in many districts, encouraging the farmers to dig wells and pump water through lift irrigation schemes,—all these schemes should be explored in full and must be given top priority.

(*b*) Improved seeds of all crops and fertilisers must be made available to the cultivators well in time in greater quantities.

(*c*) In places where the water-table in the existing irrigation wells has gone down considerably due to the exhaustion of water-supply by the fitting up of irrigation pump sets, the Government must explore the possibilities of getting more water through these wells, by sinking bore-wells in such wells and a scheme should be formulated and implemented by the Government to have at least 12 boring sets and give them on hire to the farmers.

(*d*) Another common difficulty experienced by the ryots in all the districts is the abnormal delay in the supply of electric current to the installation of irrigation pump-sets for wells. The Government should prevail upon the Electricity Board to see that all applications from the ryots are executed and expedited within two months from the date of application so that they may not experience disappointment and frustration.

(*e*) At present a cultivator who takes up a new installation of irrigation pump-set working on electric current has to purchase a time meter at his own cost, and each such meter costs about Rs. 300. Since the Sharavathi Hydroelectric Project is likely to be completed soon, power supply is likely to be available in abundance in another two years and the existing restrictions of the power supply during night times likely to be relaxed by the Government. In that case these time meters purchased by the cultivators at present will be a waste thereafter and they do not serve him any purpose. To get over this difficulty

it was felt by the group that these meters should be purchased by the Electricity Board themselves and supplied to the cultivators on monthly hire basis.

(*f*) To popularise the Japanese Method of Paddy Cultivation it was felt that the weeders should be supplied to the cultivators on a subsidy basis as in the case of sprayers and dusters.

(*g*) The recent order of the Government enhancing the loan limit for sinking wells from Rs. 750 to Rs. 3,000 was welcomed by the group but at the same time the group felt that these loans should be disbursed to the farmers expeditiously by enhancing the powers of the Block Development Officers to that extent if possible.

(*h*) The service of soil testing by the Department of Agriculture free of cost to the cultivators is in many places not fully known to the cultivators. To overcome this difficulty it was *resolved* that an intensive programme of propaganda amongst the villagers is necessary by the extension staff of the National Extension Service and Agricultural Department. Further this item of news should be published in the monthly Journal of the farmers' Forum in every issue and also in the other journals of the Government. Arrangements must be made to communicate to the parties the results of soil testing within a week or fortnight.

The group felt that more active participation of non-official bodies like Farmers' Forum and Young Farmers' Association is necessary in the villages in educating the masses in improved techniqucs of agriculture and also they should enrol more number of members to these organisations.

After studying the question of research stations, the group felt that the following additional research stations are required for the crops noted below:

Ragi—6—in the Ragi Growing Districts of the old Mysore area.

Jawar—1—in the Mysore District.

Pulses—1—for the West Coast Districts of South Kanara and North Kanara. 1—for the old Mysore Area.

Regarding improved strains of crops it was felt that there are enough number of strains for paddy, ragi and jawar crops but in the case of pulses it was felt that there were no suitable varieties for many regions and the opening of breeding stations as suggested may solve the problem.

It also came to the notice of the group that strains evolved by the Department are quite popular with the ryots but in certain places they

are not reaching him in time and in adequate quantities. To overcome this difficulty the group felt that more number of seed farms should be opened by the Government to produce quality seeds and also steps should be taken to see that the seeds produced by the registered seed-growers at present are purchased, stocked and distributed by the co-operative societies at the village and block levels.

Regarding research it was felt that almost all the problems of the farmers have been either worked out or being worked out in the research stations. But at the same time, some members felt that losses to the farmers by shedding of grains in the fields and by pests like stem-borer and blast diseases on paddy are problems that require working out in more detail.

The group felt with regard to Babbur Farm that research on paddy pertaining to the Vani Vilas Sagar Area may be taken up intensively on the farm.

The group was of opinion that suitable legislation may be under-taken by the Government to eradicate the menace of stray cattle causing great losses to the crops.

The group felt in general that the cultivators should be given crop produce loans on the security of crops that are being raised instead of on personal security as done at present.

Under the leadership of Mr. John H. Webb, Adviser, Farm Organisations, Technical Co-operation Mission, New Delhi, the International Farm Programme Participants (Southern Region)—I.F.P.P. (Southern Region)—met at Bangalore on the 16th, 17th and 18th of May 1960. This organisation was started to co-ordinate the activities of those who have visited foreign countries under the Farm Programmes and bring about the development of the country's Agriculture through their deliberations and services. At the first meeting, Working Rules were framed and plans laid out to hold the meetings of the group in the participating, States namely Mysore, Madras, Andhra Pradesh and Kerala.

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